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Forthcoming Events.

APRIL 3.

Institute of British Foundrymen (Lancashire Branch):—Annual general meeting at Manchester. "Pattern-making and its Relation to Design and Foundry Practice," Paper by R. Kemlo.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Detroit Conference.

It should be unnecessary to emphasise such platitudes that "no person, firm or country, has a monopoly of knowledge of the technique of an industry," or "that when opportunities are afforded for a general meeting of the best brains in an industry for the mutual discussion of common problems, the live men of that industry cannot afford to be absent." Yet we are aware of a number of foundrymen who are still debating as to whether or not they should be represented at the forthcoming International Convention to be held in Detroit next autumn. From what we learn, Germany has thoroughly made up her mind that the trip is well worth taking and exceptional interest is being shown. More than 100 persons have filled in the preliminary questionnaire which insures that they will be kept advised as to every step in the development of the project. The number of persons in Great Britain who should have emulated the German example is in the region of 3,000. If any of our readers have failed to receive one of these questionnaires, they should write to Mr. V. Delport, 2 and 3, Caxton House, Westminster, London, S.W., the European representative of the American Foundrymen Association's Committee on Foreign Relationship. Unless a founder is convinced now of his total inability to attend the Detroit Conference, then he should satisfy himself that he has taken the necessary steps to ensure that he receives the fullest information as to the progress the scheme makes. It matters little or nothing in which section of the industry a founder may be engaged, for we are assured that the programme has been so arranged that he will have the privilege of inspecting modern plant engaged upon similar or closely allied work. If after perusing the list of firms who are so kindly opening the shops for inspection and one fails to find any of direct interest, then a letter should be sent to the authorities drawing their attention to the omission, as they have sought to make the activities as comprehensive as possible.

The Exhibition, which runs concurrently with the Congress, will undoubtedly contain large numbers of specialised engineers who will be in a position to arrange for demonstrations of their machines working on products in plants not scheduled to be visited.

In dealing with this aspect, it should be clearly understood that it is extremely unlikely that, as a result of a works inspection, the visitor will take away something which is directly translatable into practice in his own works, but rather will he create in his mind a new series of standards. Some of these will be higher and some lower than his own, but there will be clearly shown in what department progress can be made. Mr. Chell, who has recently visited the United States of America, found that it was in cupola management where progress could be made. Mr. Stubbs, after his visit, was impressed by the finish of the patterns for small repetition work. Others have been impressed by the weight of castings produced for each man-hour expended.

The main benefit is on return, when one has these factors clearly in mind and ways and means adaptable to existing conditions are evolved.

Notes on the Production of Castings.

At a meeting held at the College of Technology, Manchester, last Saturday, of the Junior Section of the Lancashire Branch of the Institute of British Foundrymen, MR. ARNOLD HODGKINSON gave a general talk on foundry work. He confined himself more particularly to the explanation of difficulties.

The scientific side of the art was receiving much attention. It was becoming a fact that machinery was successfully being introduced into the foundry. There would always be, however, a need for the skilled craftsman.

Cupola Practice.

The cupola, as used in this country, was of one type only—the only variations being those of the type of bottom employed. Any tuyere arrangement which allowed the introduction of the correct volume of air was a good one. The air should be introduced into the wind belt tangentially; some 2.5 horse power had been saved on a furnace when the vertical pipes had been replaced by a tangent pipe of ample dimensions. The importance of good fluxing and the use of fluorspar in conjunction with lime was touched upon. The beneficial effect of the use of a mixing ladle with furnaces of the non-receiver type lay in that it helped in thorough mixing, and was less dangerous than direct catching under the spout. The importance of mild steel scrap, as an aid in overcoming the scrap problem, was cited.

The Sand Problem.

Too much attention could not be given to mould facings, which should be applied as thinly and evenly as possible. Too much sleeking was to be studiously avoided. Permeability was greatly affected by the grain size, and distribution, and moisture content. Sand should not be crushed or ground in the milling operation, as this adversely affected the permeability. Sand grains which had been subjected to heat influences readily fractured along the cleavage planes, and materially affected the average grain size.

Coal dust, sawdust, and other carbonaceous materials were added to ensure porosity. A self-venting sand was the ideal one.

Venting and Cores.

Venting was important—but required much skill, especially in the case of cores. A common fault in core making lay in the faulty design of core irons. These were frequently too rigid, and resulted in cracked castings quite often. Where fusion of core sand occurred, the use of ganister in the last layer of the swept-up cores would help to remove that trouble.

Vents were often made up with small coke fragments; gas coke should on no account be used for such a purpose.

Causes of Defects.

Running cylindrical castings from the bottom was advocated. Half-couplings were very successfully run by pencil runners in the cores. Rings and frames were best run from a central runner. Unequally-sectioned castings should be cast by running the thick section through the thin one. The shape of the runner was important. Filter gates were likened to the anti-splash device of water taps. Their use was fully justified, particularly where castings had to be machined all over. Cone-pulleys were a typical example of castings so run. Simultaneous solidification was to be aimed at in order to produce solid, clean castings. Disposition of runners and risers was the controlling factor. Symmetricity of gates was very important where thin sectioned castings of large area had to be run. With gates symmetrically arranged very little "pulling" would occur. The use of moulds constructed entirely of cores was advocated for many castings. Such a procedure produced castings which needed very little fettling.

Discussion.

In the discussion, MR. SUTCLIFFE pointed out that in the modern sand mill the roller was clear of the pan, and the motion was not a crushing one. The roller was only lowered when loam or ganister needed grinding. The use of ganister as a finishing coat to barrel cores seemed poor practice, it was certain to crack on stoving. Slow running with pencil runners had been advocated, but he could get equally good results by quick running and the use of the feeding rod.

MR. KEY asked whether the filter cores were "anchored" to avoid flotation.

MR. MAKEMSON said he had seen such cores in use, and no flotation occurred until the mould was quite full.

In reply, the LECTURER said that the use of the Ronceray runner had made certain castings almost a 100 per cent. good ones every time, and that spoke for itself. He had used that type of runner long before it had appeared in the technical Press. The filter cores in large moulds were sprigged for safety, but he had never seen one float. The core was tapered to fit the bush, and there was a space under the core above the box top. For very small jobs the core could be bedded into the mould top, and so dispense with a bush runner. The filter core was a proved success.

Catalogues Received.

Cast-Iron Pipes.—The March Monthly Stock List of Cast-Iron Pipes, issued by the Staveley Coal and Iron Company, Limited, of Chesterfield, is now available.

Foundry Equipment.—The Pneulec News for March—a form of advertising adopted by the Pneulec Machine Company, Limited, of Mafeking Road, Smethwick, Birmingham—describes and illustrates moulding machines, cupolas, oil sand mixers, swing grinders, ladles, stoves, and oil-fired furnaces.

Pulley Blocks.—In Book 108, a 32-page catalogue, Messrs. Herbert Morris, Limited, of Loughborough, describe and illustrate a series of pulley blocks of capacity ranging from ½ to 20 tons. Actually there are two sizes below ½ ton, but these are for special purposes. Whilst the catalogue is quite general in its appeal, it includes much data of interest to foundrymen.

Pulley Blocks.—The Universal System of Machine Moulding and Machinery Company, Limited, of 97, Queen Victoria Street, London, E.C.4, have prepared a 4-page leaflet describing a range of "Exo" pulley blocks, the principal characteristics of which are lightness and reduction in lost height over the American type. The range includes from ½ to 32 tons lifting capacity.

Paddle Wheel Fans.—We have received from Messrs. James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.4, a 16-page pamphlet printed on art paper. The capacities of the fans described range from 2 in. to 6 in. W.G., and in size from 10 in. to 32 in. The pamphlet is not taken up with numerous claims, but is almost entirely devoted to technical data, which makes it definitely "worth while" for foundrymen and engineers to file.

Flexible Couplings.—It is almost impossible to ensure correct alignment when a motor is directly coupled to the shaft of a machine and some form of flexible coupler is now recognised as being essential. There are numerous ways of accomplishing this, but most of them appear to be covered in a 40-page pamphlet which we have received from Messrs. Crofts (Engineers), Limited, Bradford, Yorks. The book contains a good deal of useful technical data. It is available to our readers on application.

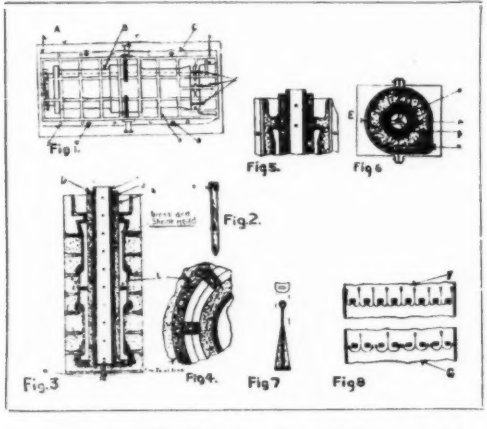
THE PNEUMATIC ENGINEERING APPLIANCES COMPANY, LIMITED, of Donington House, Norfolk Street, London, W.C.2, manufacturers of the improved "Peacolt" pneumatic moulding machine, have received orders for these machines from all the "Big Four" British Railway Groups. They are for the most part employed upon the quantity production of R.C.H. Standard axle-boxes, which have to be cast to very fine limits in order to ensure interchangeability. Owing to the reputation achieved by the improved "Peacolt" for Standard axle-box work, the impression is held in some quarters that the machine was specialised for this particular purpose. This, however, is an entire misunderstanding, as it is essentially designed and adapted for general foundry use. The fact that the improved "Peacolt" has been conspicuously successful on Standard axle-box production is merely one testimony to its all-round capabilities.

Comparisons in Foundry Methods and Processes.*

By E. Longden, M.Inst.Brit.F.

Quite interesting are the various methods and processes employed in foundries to produce castings. As a first example, take sands. The quality and availability of moulding sand for each district creates modification of ramming, venting and finishing of moulds. In Lancashire more milling of sands take place than in the Midland and Southern districts. In some cases manure is introduced into facing sand which is to be used for greensand moulding, and in other districts such an addition is only made when mixing for dry sand and loam practice. In many foundries a dozen different mixtures of sands are in use, and in others, making identical work, perhaps only two or three. The practice of casting in dry sand or green sand also varies accordingly.

In a number of foundries green-sand moulds to produce castings up to 4 tons are never faced with plumbago or any other refractory coating. Just a simple dusting with plumbago is more common, but in the majority of foundries green-sand moulds above the very small are blackened with plumbago and sleeked. Again, a dry sand mould may be wet-blackened, rough-sleeked, dusted with plumbago, well-sleeked all over, and finally washed over with a thin solution of blacking and gum water. In another district or shop a similar mould will be finished by rubbing plumbago on the mould face, using the hand and



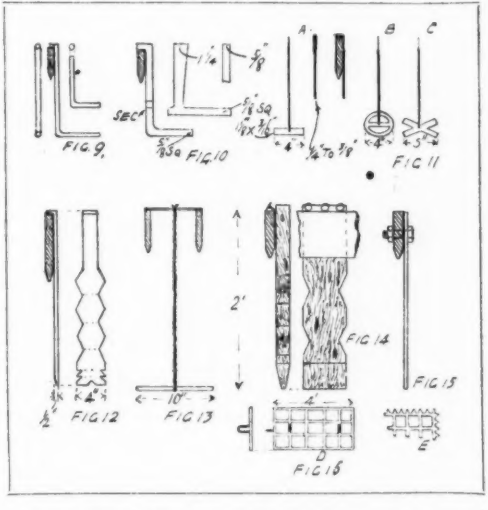
camel-hair brush, sleeked and washed over with a thin solution of blacking and gum water. In a foundry in the Midlands making heavy gas and oil engines, dry-sand moulds are well finished before applying any refractory coating. Whilst green, a mixture of plumbago, terra flake, clay water and gum is applied, using the best camel-hair brushes. After drying the moulds, whilst still warm, are again painted over with the same mixture diluted. Excellent good-looking castings are produced, comparing more than favourably with the moulds which are heavily wet-blackened and sleeked. With loam-moulds, either strickled or when worked to a pattern, more than one way of applying a refractory is practised. After a loam-mould has stiffened it may be finished and blackened like a dry-sand mould. But in most shops loam-moulds, especially strickled, are thoroughly dried and painted with blacking whilst still warm. The same variety of practice applies to cores.

In some foundries it is the custom to face-sprig the mould in the locality of the in-gate to prevent scaling or scabbing of the mould face, which is due to generation of gas in the sand face or local expansion of the mould caused by excessive heat. In other shops employing a different mixture of sand and gating methods, face-sprigging is almost entirely absent.

During the author's apprenticeship he worked in a Lancashire foundry which acquired a high reputation for the production of medium and large steam- and gas-engine cylinders, etc. At that time the foundry manager was often seriously discussed by the moulders. This manager would require from them a good day's work, but they failed to understand why he caused valuable time to be consumed by compelling them to face-sprig heavily all cods or upstanding pieces of sand and fillets of every description. After some thought about this custom it became evident that the purpose actually was slightly to chill or densen the metal in the places where porosity manifests itself. Undoubtedly that was the principal object, because one-tenth of the sprigs habitually used would be ample to prevent prominent parts of the mould face washing before the metal.

Oil Sand Cores.

There are not many foundries where core oils are not used for the production of cores and moulds. There are extremes in the use and views of oil-sand cores. In certain foundries nearly all types of cores are made in oil sand, and in others only a very limited number or none. It is a fact that were it not for the development of oil as a core binder, the production of certain classes of castings used in the motor car trade would be



almost impossible or at the best a very risky and expensive production. But it must be remembered that the great majority of cores will be finally more cheaply made from the ordinary sands. The decision as to whether a core should be made in oil sand or otherwise will depend on the size, bulk and the location of core in the mould.

The following points may be noted: Oil sand has its limitations. The employment of oil sand for producing and protecting vulnerable sections of a mould and in certain cases as a facing for the whole of the mould is now being developed. Oil-sand slabs with rods can be used as sand lifters.

Fig. 21 gives just one example of their sensible use to produce a casting weighing about 30 cwt. which is machined top and bottom. For years castings similar in principle to the design shown had been made in green sand, including the inside the reverse way up to the one illustrated, resulting in a fair percentage of waste when made by a very skilled moulder. The method was changed for the one shown in the illustration with core openings top side. A core box was made slightly smaller than the openings in the pattern. The cores, after drying, were placed in the pattern to be secured when the top part had been rammed directly on the top of them. It will be seen that the cores are easily bolted to the top and are firmly seated.

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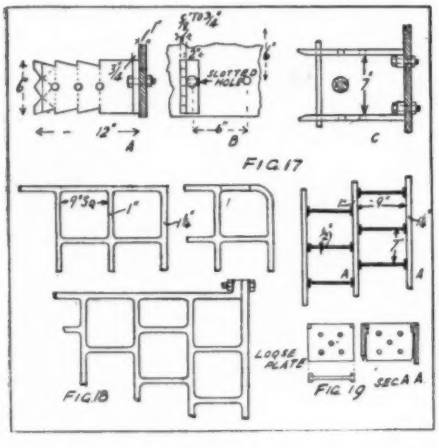
* A Paper read before the London Branch of the Institute of British Foundrymen, Mr. G. C. Pierce presiding.

Wooden Frames.

No foundry should be without a number of wooden frames, the insides of which should be smaller than the inside of the moulding box. Instead of immediately placing the drag part over the pattern, place the wooden frame and ram the sand around the pattern with greater ease. With certain complicated patterns it is sometimes very laborious to ram sand through the bars of the box. By using a frame as suggested, the ramming of sand, release of loose pieces, and locating of loam cakes can be comfortably accomplished before placing the moulding box in position. It is then only necessary to ram around the outside of the sand represented by the difference between the size of the wooden frame and the moulding box.

Notes on Moulding Tackle.

Fig. 9 shows the most commonly used wrought-iron lifter or gagger. They are made in various lengths. Fig. 10 illustrates two types of cast-iron gaggers. The design seen on the right is very useful. The short toe on the lifting foot allows of more effective use with less danger of sand being detached when the upright side is placed too close to the pattern. The taper of the vertical portion also reduces the tendency of the lifter to fall out of the sand. Such lifters are quickly made in open sand by stamping from a board pattern. Fig. 11 illustrates wrought-iron lifters fashioned in various shapes to suit the



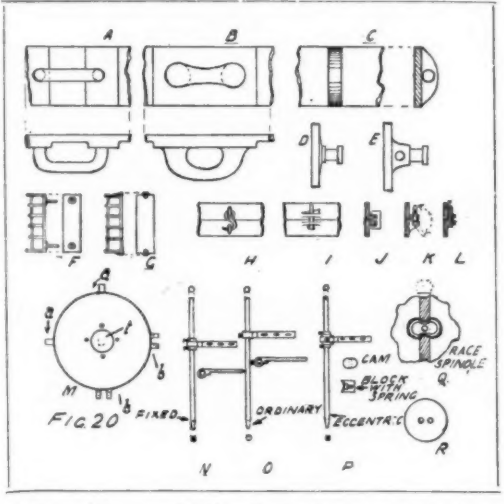
sections of sand to be supported. The left-hand sketch is the type commonly used in the foundries which have adopted this principle. As indicated on the sketch, the upright portion is made from ¼-in. to ⅜-in. wrought-iron flattened about 3 in. at the top end. The foot is formed from flat-sectioned wrought iron. A hole is punched in the centre of the foot and the vertical rod welded in. When the mould has been rammed up the flat portion is bent over the box bar. It is more economical to adopt this type of gagger, because deep-lifts can be rammed up before placing the top part box. Fig. 12 shows a loose cast-iron bar supported by the box bars. On an emergency, such bars are easily and quickly made. Fig. 13 illustrates the use of a straight, round piece of wrought iron suspended by a twisted wire from the bars. Figs. 14 and 15 illustrate the fashioning of emergency lifters. In Fig. 14 is shown how a wooden bar is supported by driving flat-headed nails into the woodwork to clip the bar. Again, in Fig. 15 the illustration shows plain flat bars bolted to the box. Fig. 16 is a sketch of cast-iron grids for supporting sand. The one on the right with serrated sides being the best shape.

In the next sketch, Fig. 17, is depicted a very useful form of bar which can be employed when constructing medium and heavy castings in boxes above the foundry floor. The bars are very cheaply made in open sand. It will be noted that the bar is notched and broken up by holes to enable easy fracture or lodgment for lifters. Sand in the front of runner gates can be made very secure by inserting wrought-iron rods through the holes from bar to bar as shown in the plan on the right-hand side.

Fig. 18 indicates the cracking of top-part boxes when made as pictured in the sketch. Very little improvement can be noted when the corners are rounded. The bottom sketch suggests the correct way. The box corners are split by inserting a strip of tin across the section of metal and bolting together after casting.

In jobbing foundries it is often necessary to break away portions of a box bar to allow a boss or upstanding portion of the pattern to penetrate the top part. Fig. 19 is a sketch showing how loose bars are easily adjusted or removed when necessary. The loose bar is simply dropped in slots provided and secured by wooden wedges.

Fig. 20 illustrates comparisons in box-lifting handles, trunnions and fasteners: (A) is an ordinary wrought-iron handle; (B) is a cast-iron handle; (C) shows cast-iron rocker-arm handles; (D) is an ordinary trunnion; (E) is a combination of trunnion and locating pin-hole; (F) shows cast-in box handles; (G) a box with holes for loose handles; (H) a hook fastener for securing boxes; (I) shows cotter and cotter pins; (J) an ordinary clamp; (K) shows swivel cotter pins; (L) illustrates wedge between pin and box side; (M) at a. a. shows an ordinary handle on loam plates, but at b. b. a more serviceable lifting handle. (As a precaution to prevent fracture of large open sand-moulding plates, a hole should be formed in the centre. A loose plate is then bolted



in position to blank off the hole.) (N) shows fixed spindle for loam moulding; (O) is a round ordinary spindle; (P) is an eccentric spindle for striking up moulds to allow of splitting or producing castings in halves. The arm is supported and located in the required position on the spindle by a cam above and below. The arm is rotated round the cams guided by rollers. A spring adjustment keeps the arm taut. This type of spindle can be employed when it is desired to use from ⅛-in. to 2-in. splitting cores to divide a mould into two halves; (Q) gives a rough idea of the race-spindle used for striking moulds to allow about 6-in. splitting cores to be used. In the ordinary way, when it is desired to strike up one mould to form two complete halves, a plate is used with two centres as shown at R. In this case the spindle is moved from one hole to the other to create the space for splitting cores.

Gas- and Oil-Engine Pistons.

Fig. 22 illustrates two of the best methods of moulding large gas- and oil-engine pistons. The left-hand drawing shows a method adopted to enable moulding by machine or plate. One half-pattern is dowelled on the machine-plate from which two half-moulds are made to form a complete mould. A thickened box bar sits on the gudgeon-pin core-prints, thus forming a sturdy bearing for the body-core through which the loose gudgeon-pin core is threaded after drying. The moulds are jolt-rammed horizontally, and after drying and closing, turned up to be cast vertically. The main core is rammed up vertically,

supported by a stout core-iron and vented by wire holes thrust down to the bottom of the core-box. The tops of the vents are connected together by a ring of cinders just below the top portion of the core-iron. The mould is poured by way of a runner gate passing through the core. Details of the moulding-box design are clearly seen in the sketches except the box bars, which are made in the usual way and conform to the shape of the pattern.

The right-hand sketch gives details of another excellent method of moulding pistons. Round moulding boxes and a full pattern are employed. It will be noted that although moulded vertically, only one joint is seen at the bottom of the mould. The core sits in a machined metal-print which is part of the moulding box (see A left-hand drawing in the sketch). The core is made in a similar way to that already described for the previous method, except that the main core and gudgeon-pin core are together as one piece When closing, the upper portion of the moulding box is placed temporarily on the bottom part. The core is then lowered into position, top box is then lifted, and the core viewed from the underside and thickness checked. After lowering the top on the bottom part and cottering together, the special runner box is adjusted across the top of the core and securely fastened by cotters through the pins as shown at B in the sketch. As in the first-mentioned method, the mould is poured through the core. Either of the methods outlined can be thoroughly recommended, both on the score of cheapness and soundness of casting.

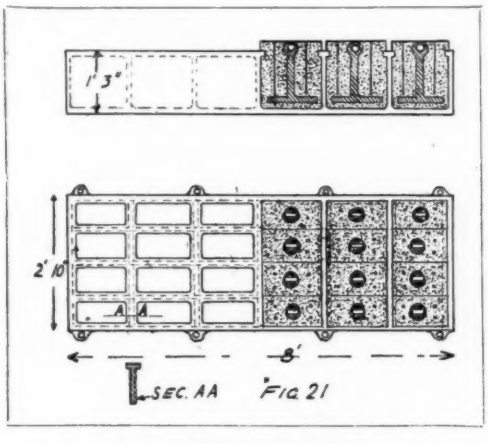


FIG. 21

Gas- and Oil-Engine Liners.

Figs. 1 to 8 show the methods of moulding on a very economical scale sound liners for steam, gas or oil engines. Fig. 1 shows half-liner pattern mounted on a moulding machine plate with the box located ready for jointing. Fig. 2 shows the box bar, and Fig. 3 a left cross-section of assembled mould. Fig. 4 illustrates the right-bottom core arrangement, and Fig. 5 a part cross-section of assembled mould at right-angles to Fig. 3 being the joint line. Fig. 6 shows a plan of the mould ready for casting, and Fig. 7 the pouring basin plug, whilst Fig. 8 explains the advantage gained by pouring the liners by way of four drop gates.

The sketches should almost explain themselves. It is only necessary to construct one half-pattern and correctly dowel on a machined cast-iron plate or moulding board. Each half-mould, being exactly alike, will make a complete liner when assembled. The runner basin is formed at the same time as the outline of the liner. After jolting it is only necessary to paint the mould with blacking. After drying, the mould is quickly cored and assembled. It will be noted that the core is bolted down at the bottom end and that the port cores are short of butting the main core by about $\frac{3}{16}$ in.; also holes are cut through the port cores to induce scum and gassy metal to pass from under the cores. The main core is made from machined-iron core-boxes. The barrel is wound with straw band, placed in the centre of the iron core-box, and rammed vertically with a good refractory sand. Fig. 8 explains the scheme for the running of the castings. If eight gates were used, scum would be trapped under the port cores as indicated at F. By pouring through four gates as described in the lower sketch G, direction is given to the metal so that dross tends to rise between the port cores to be finally floated into shrink head. This example explains the production of a steam-engine liner, but exactly similar moulding method would apply when making gas or oil-engine liners.

Hinged Moulding Box.

Fig. 23 gives the outline of a box-shaped casting. In the ordinary way a block pattern and core boxes would be made. All foundrymen know the risk of waste which such a casting presents. Ample clearances for cores must be allowed to avoid joint crushes. Sections are not uniform, and after casting the core irons must be taken out to avoid the breakage of the castings on contraction. An alternative method of producing such castings cheaply is by a development of the hinged moulding box. A pattern is made in sections—four sides, top and the bottom internal flanges which, when screwed together, resemble exactly the intended casting. It will be seen that the core is made in green sand as part of the mould. In making the moulding box the sides of the drag are hinged to the bottom part so that when brought together vertically they can be located and secured by horizontal pins and pin-holes. The top box part is of the ordinary type, being located and fastened

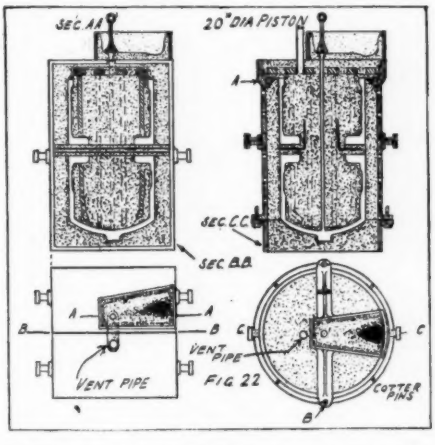


FIG. 22

to the drag sides. Fig. 25 shows the design of the hinged box sides.

To commence moulding, the box is levelled and the hinged sides lowered to the horizontal position; the bottom box is then rammed with sand and a surface prepared to receive the assembled pattern. Boards are clamped to the openings in the sides, the runner gates are located to allow the metal to pour into the mould by way of the bottom flanges, and rammed with sand. During the ramming the core is liberally vented with the rod and cinders. After removing the temporary boards, the vertical panel joints are formed and the hinged sides lifted to the vertical position. The vertical diagonal joints at the box corners are formed by the flanges on the sides meeting within about $\frac{3}{16}$ in. of the mould face. The outside of the pattern is then quickly rammed. After making the top horizontal joints, the top box is placed in position, the gate sticks are located, and the job is rammed in the usual way.

To take off the top part and lower the hinged sides is the work of a few minutes. The pattern is unscrewed and removed in sections. With the mould open in this manner the workman has easy access to every part of the mould, enabling him to produce a very presentable casting. The mould is quickly made ready for pouring.

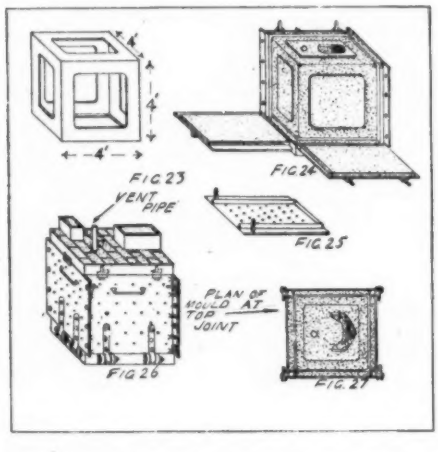
The moulding method outlined is very economical in production when compared with the common and risky system of producing such castings in the ordinary way with a core to form the inside and panel openings. The method can be applied to many box-like castings.

If the shape of casting will allow it, the ramming of the inside can be reduced by fastening a perforated box to the bottom part, allowing about 3 in. of sand between the box and pattern. If this is done the castings must be eased to allow for contraction when cooling. When not required for the type of casting described, the hinged box can be securely fastened together and used for ordinary work. Obviously the dressing charges are reduced to the minimum. The clearances which must be allowed when coring in the usual way are unnecessary with the hinged moulding-box method.

Fig. 24 shows an open mould and Fig. 27 a plan of the top joint, showing how the bars attached to the hinged sides meet at the corners to form the vertical joints, etc., whilst in Fig. 26 the complete assembled mould ready for casting is shown.

Cupola Design.

Much has been said about the ideal cupola of late years, but in spite of all the theoretical formulæ and figures which have been put forward little improvement in cupola-furnace working can be recorded, nor do we learn of any considerable research or systematic investigation. There is no doubt that the observant foundryman will complain that, although he has many opportunities of noting cupola operations, his time is too earmarked by duties other than that of cupola design. Again, the purely metallurgical man, with his formulæ for chemical combinations, gas pressures, and so on, seem either to have been miscalculated or there are missing factors



or elements which have not been taken into account. However, the actual cupola manufacturer appears to be the right individual to deliver the goods.

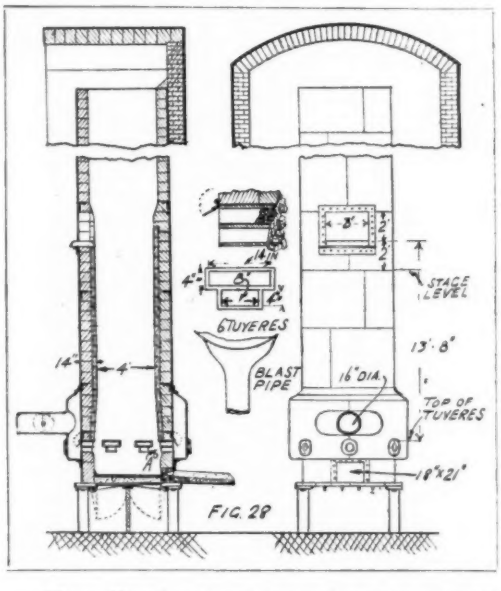
When designing a cupola the following features must be carefully considered: Height from bed or hearth to slag hole; distance from tuyeres to charging door, and height from charging door to top of stack. All must be in relationship to the diameter of the lining, and the tuyeres in a certain approximate ratio to the latter. An air belt of ample capacity to act as a reservoir and conduct air to tuyeres must be provided. The air belt should be fed by a suitable delivery blast main of more than sufficient area.

By studying the outlines in Fig. 28 many points will be apparent which are not quite in accord with present cupola design and working. Such a cupola will give 9 to 10 tons per hour, averaging over a 5-hour blow. A delivery blast-pipe, 16-in. internal dia., enters straight into a belt of ample proportions encircling a shell of the usual construction to which is attached cast-iron brackets supporting the lining. The height from the bed to the slag hole is 18 in.; from the bed to the top of the specially designed tuyeres, 30 in.; from the top of the tuyeres to the charging door, 13 ft. 8 in., and from the charging door to the top of cupola not less than 20 ft. The shell is lined with two layers of firebricks. The diameter of the lining formed immediately above the tuyeres is 4 ft. 4 in., inclining over a height of about 3 ft. 6 in. to give a diameter of 4 ft., which continues to the top of the charging door. The illustration also shows a simple firebrick canopa to act as a spark arrester and the drop bottom.

The design is the outcome of the following reasoning. Linings are usually formed with one row of large bricks to about 3 ft. above the tuyeres. This is wrong in principle. The sketch (Fig. 28) shows the bosh to be formed by one row of large bricks, from the tuyeres upwards two rows, the front layer being 8-in. × 6-in. × 4-in. bricks.

The ratio of erosion of lining in large cupolas is greater than in small cupolas. With the lining constructed as described, renewal of lining in the melting zone is easily and quickly accomplished. Such a renewal should take place once each week. During the week the erosion of lining is partly made good by daubing with the best refractory or ganister. A good shape is thus maintained continuously. A good furnaceman and a helper will take out and renew the bricks in the melting zone in about 4 hours.

When the lining is formed by one thick layer of firebrick considerable trouble and expense is entailed to reline. It usually happens that the erosion is partly made good by daubing with ganister and setting loose bricks until the lining must be renewed back to the shell. With a lining such as has been described in the sketch the back row of bricks need not be disturbed for a number of years.



The uniformity of melting and quality of metal is considerably influenced by the formation of slag. The cleaner and brighter the tuyere looks, the better the melting and metal. The shape of tuyere has an important bearing on the action of slag. Bridging commences immediately above the tuyere, where slag is chilled by the incoming cold air. After a time, when the bridging has increased, a very rapid erosion of lining takes place, due to the fluxing action of slag which is held above the bridge by the strength of the blast. Molten metal also lingers on the bridge, and may find its way into the bosh by trickling down the lining through one or more holes kept open by the blast. The metal, when it takes such a route, increases the fluxing of the lining, and often enters or melts part of the front of the tuyere.

One row of tuyeres splayed out to give an almost continuous ring of air does not not prove to be the best way of admitting the blast. With such tuyeres, bridging is more pronounced and completely encircles the lining above the tuyeres. Bridging proceeds rapidly after about one hour's blow. In theory the one row appears ideal, the object being to narrow the zone of combustion. But with the present type of tuyere undoubted success has been achieved. They are not so successful as when employing two rows of tuyeres.

As before stated, with one row of tuyeres bridging is continuous, so that there is no hot place on the lining to allow slag to fall into the bosh of the cupola. Thus a cold ring of slag begins to form, growing at first slowly, then rapidly, allowing lodgment for not only slag but metal also, the latter being aided by the strength of the blast. Thus a rapid erosion of the walls take place, due more to slag-forming reactions than to actual temperature. To the author's knowledge, it has never before been explained in this way. The superiority of restricted, two rows of tuyeres is because hot areas are left open on the walls for release of slag. This is the reason why it is possible to continue blowing longer when using two rows of tuyeres. Fig. 29 shows approximately the condition of a 9- to 10-ton cupola after blowing about four hours. Slagging is very pronounced in the left-hand sketch, using one row of tuyeres. With two rows, better results were obtained, and with three rows again slightly better results.

With cupolas of 3 ft. 6 in. dia. and upwards the employment of a fan for blast in conjunction with the continuous row of tuyeres is not good practice, and it is preferable to use a blower, especially for large cupolas.

To secure the effective realisation of creating only one vigorous and rapid melting zone across the entire cross-sectional area, it is desirable to remodel the tuyeres in such a way to reduce the tendency to bridge. In Fig. 28 it will be seen that the tuyeres are constructed with two compartments, the area of the power aperture allowing the passage of about 75 per cent. of the required air, and the top opening allows the passage of the balance, when the lining front of

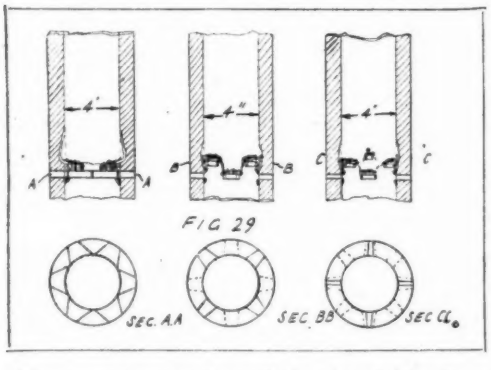


FIG 29

this compartment is packed with fairly large pieces of coal. The object is to keep the lining above the tuyeres hotter than is the case with the ordinary splayed tuyere. The blast driving through the bottom section meets immediately above heat-forming material instead of the brick lining. Furthermore, the remainder of blast percolating through the interstices of the coal combines immediately with the coal gas, giving a hotter area about the tuyeres. Any metal or slag which drops on to the coal creates rapid ignition of gas and the tendency to keep warm about the tuyeres. Also any tendency for slag to form can be counteracted, because the material is easily dislodged by using a bar through the tuyere when renewing the supply of coal, whereas in the ordinary way the slag sets quickly on the comparatively cold lining. The top compartment is supplied with a door which, on occasion, might be closed. It may here be pointed out that the doors must be used with discretion, because the top and middle of plate of tuyere would soon be melted. This is the only weak point.

When clearing away solidified slag from the front of the tuyere care should be exercised so that the obstruction is only dislodged on the bottom side of the tuyere. Much of this disturbed material then falls into the bosh of the cupola. If the obstruction on the top side of the tuyere is disturbed it is unlikely that it will find its way into the bosh. It will invariably cause a rapid blocking of the tuyere. The obstruction takes shape all round the nose of the tuyere.

The slag hole should be about 3 in. below and midway between two of the tuyeres and as near the tapping spout as can be conveniently arranged. Here, again, the object is to keep the slag as hot as possible to facilitate easy removal when slagging. If the hole is placed too near the tuyere the slag is chilled, and does not flow freely. By locating the slag hole between the tuyere on the spout side the tendency of the slag to follow the metal is taken advantage of. When the hole has been opened the blast should be reduced for a few minutes to induce the slag which is held above the tuyeres to fall into the bosh. It is sometimes wise to stop blast altogether for about three minutes after opening the slag hole.

With the capacity of cupola here discussed, slagging should take place about 1¾ hours after commencing blowing, and at intervals of ¾ hour until finished. The period of slagging should be about ten minutes, as all slag can be tapped quickly by allowing metal to rise in the bosh.

Solid and Drop Bottoms.

With respect to solid and drop bottoms, the advantages are not all on the side of the drop bottom. The solid bottom is practically free from all danger of break-away of metal, and only needs substantial repair about once each week, but after melting, furnace material must be raked out, and this is a hot and laborious job for a few minutes. With the drop bottom the contents of the cupola are quickly precipitated and the furnace shaft cooled. Each day the furnace hearth bottom must be renewed. The danger of a leak is always present, due either to the bottom doors warping, improper ramming, scabbing of sand from wet material, and incorrect venting. To minimise danger of bottom doors warping arrangements should be made so that the joints of closed doors are at right angles to the spout, if only one of the latter is used. The doors should also be constructed with strengthening ribs and brackets to counter warping. Hinge pins should be renewed when only slightly worn to prevent the instability of the bottom when ramming. When preparing the bottom, black sand, not too damp, should first be fed in and be soundly peg-rammed. Rods ½ in. dia. are then laved across the sand protruding through the fettling door; black sand again spread over and trampled with the feet; finally spread enough red sand to give, when well trampled and well flat-rammed, a thickness of about 1½ in. A good furnaceman will vary the thickness of the red sand, according to the metal to be melted.

If it is necessary to have a spark arrester, a brick canopa should be erected, as shown in Fig. 28. All metal spark arresters are liable to corrosion, but those with firebrick lining are much better. In most cases there is interference with the upward flow of gases which affects the melting, and at frequent intervals makes it very uncomfortable and difficult for the furnace men to charge material due to the back flow of gases. The more complicated the arrester the less efficient. A good length of stack will considerably help the work of the spark arrester.

Much has been said about ratios of coke to metal melted, but the first and most important function is to melt hot, well-mixed metal, and that cannot be done without sufficient coke of good quality, no matter how the air supply is manœuvred. Authorities give figures for bed coke above tuyeres as low as 18 ins. up to 30 ins., without adding that, especially in large cupolas, the burden will carry the bed down from 3 to 8 ins. It must also be remembered that a 10-ton an hour cupola may take up to one hour to charge full; during this time the bed has been burning. With a 50-ton blow from a 10-ton cupola, the bed-coke should be, before charging, no less than 30 ins. above the top of tuyeres. Although the walls indicate that the hottest zone is about 12 ins. above the tuyeres, melting commences well above that height, and the greater the depth of this hottest zone, the higher the temperature of the resultant metal. To commence with a low bed charge spells trouble all through the blow, even if when irregularity is noted, extra coke is fed on between the charges. Due to the low bed charge, cold tuyeres are probable, to which slag melted at too low a temperature soon attaches. Before putting on the blast, the zone about the tuyeres should be at a good temperature and bright, as also should be the bed.

This can be attained by attaching a small movable air pipe to the open fettling door or tap hole. This is an excellent way to blow up and brighten the bosh coke.

Special Iron.

Cast iron metallurgy has progressed but slowly. Much has been written and said, but how much is tangible? The greatest advance in cast iron was marked by the discovery of processes to enable the regular and uniform production of pearlitic iron. The Lanz process gives an iron of wonderful properties. The average tensile strength of this metal being about 18 tons, but its most remarkable feature lies in its great resistance to impact stress. The Lanz process depends on the strict control of the elements that make up cast iron, so that carbon and silicon together, especially, are not more than 4 per cent., heating up of the moulds to a predetermined temperature depending on the average section of the casting and control of the pouring temperature of the metal. During the last twelve months the author has successfully produced this type of iron by a modification of the Lanz process by employing certain mould materials, allowing production at a low temperature.

The other patented method for making pearlitic cast iron is termed the Emmel-Thyssen process. All that the author is aware of this metal is that it can be produced by the ordinary sand-moulding method, and that the silicon is 2 per cent. and total carbon about 2.6 per cent. The metal is melted in the cupola, but it is thought that there is some modification of the hearth or receiver to secure so low a total carbon content of 2.6 per cent. Such low total carbon is unattainable except by chance in the ordinary cupola. Whilst tensile strength of 26 tons has been obtained from this metal, the impact resistance is inferior to that made by the Lanz process.

There is nothing better for gas and oil-engine breech ends and pistons than pearlitic iron of the Lanz variety.

The Constitution of the Alloys of Silver and Tin.*

By A. J. Murphy, M.Sc.

Summary.

In connection with an investigation of dental amalgams the constitution of the alloys of silver and tin has been determined from the freezing point down to ordinary temperatures. Based mainly on the results of heating and cooling curves and microscopic examination of heat-treated specimens, an equilibrium diagram has been constructed. The compound Ag_3Sn, which is the fundamental constituent in the filings used for amalgamation in dental fillings, has been examined in further detail by means of determinations of electrical resistance at different temperatures, thermal expansion and X-ray examination.

The diagram now presented differs from that hitherto accepted in showing a new phase, β, in a range of alloys formerly believed to consist entirely of an α solid solution, and also in excluding a polymorphic transformation at 232 deg. C., which was said to occur in the compound Ag_3Sn. Evidence has been obtained for a transformation at 60 deg. C. in this compound, but the nature of the change is not clear. The lines of the X-ray spectrogram obtained from filings, both aged and unaged, from an annealed ingot corresponding in composition to the compound Ag_3Sn, are accounted for by a close-packed hexagonal structure of side $2.98 \times 10\text{-}8$ cm. and axial ratio 1.6.

Experiments with pure tin and alloys of tin containing silver have shown that the presence of 0.2 per cent. of silver prevents the transformation from white to grey tin, even when in contact with grey tin.

Mr. W. C. Sample has been elected a director of Locke, Blackett & Company, Limited, in place of the late Mr. A. J. Weightman.

Engineer-Captain William Onyon, R.N., has been appointed as chief engineer of the marine department of the London offices of William Beardmore & Company, Limited, Dalmuir.

* A Paper presented to the Spring Meeting of the Institute of Metals.

Discussion on Mr. C. Dicken's Paper on "Foundry Costing."

The President (Mr. D. H. Wood) said that costing was probably the most important thing in connection with a foundry. Some people might argue that getting business came first, but unless they knew that orders taken could be executed at a profit there was not much point in booking them.

Mr. W. Flavell said the paper was brief and to the point, while the system of costing advocated was not unnecessarily elaborate and could be worked quite comfortably by a clerk in the foundry. He was opposed to too much system. He knew of a case where an article that cost one shilling to produce had to have an additional penny tacked on owing to the complexity of the system in operation. He thought Mr. Dicken's system would prove very useful to men in charge of foundries, and it could be modified to suit individual requirements.

Mr. E. J. Lewis said they must not overlook the overhead charge involved by the office staff. That cost often meant the difference between a profit and a loss. If they could turn out an extra 50 per cent. of work without increasing the overhead charge to which he had referred it would sometimes mean a remunerative job instead of one that showed no profit. He would like to ask Mr. Dicken to explain where his overhead charges began and ended.

Mr. H. J. Roe pointed out that Mr. Dicken had not mentioned anything about the floor space occupied in the different processes of moulding. That seemed to him to be a factor that required a little bit of elucidation—as to whether a job occupied 100 cub. ft. or 500 cub. ft.: it had to carry its proportion of cost according to the floor space available. The time occupied on the job must also be taken into account. Overhead charges had to be allocated according to the time occupied. Depreciation of plant was another factor that must not be overlooked.

Mr. J. B. Johnson thought any foundry manager would be in a happy position who could put his hand upon any particular job in the foundry and say at once "That has cost so much." He was not convinced at present that Mr. Dicken's system could be successfully applied in foundries where a great variety of castings were turned out. In foundries where there was less variety and a great deal of repetition it was, of course, much easier to arrive at costs. In an ordinary jobbing foundry, however, where they got fresh patterns practically every day the system described seemed to him to present some difficulties. He did not wish to criticise the system, because there was no doubt that it was a first class proposition for foundries where it could be worked. But in a small foundry it would mean doubling the staff, which was a very serious consideration. He considered costing in the pattern shop was far more difficult than in the foundry.

On the proposition of Mr. F. G. Starr, seconded by Mr. Flavell, Mr. Dicken was warmly thanked for his paper.

Discussing some of the points raised Mr. Dicken, referring to the pattern shop, said they had not only to take into account the timber but the workmanship. Take the case of a six-bore automobile cylinder: there was not much timber required but a tremendous amount of work was involved. As to overhead charges, he explained that he was basing his remarks on the cost after the pattern entered the foundry.

Sir William Ellis, managing director of John Brown & Company, Limited, has been elected chairman of Davy Bros., Limited, Sheffield.

In connection with the paragraph which appeared in a recent issue regarding the dissolution of partnership of Mr. W. E. Gunthorpe, Mr. C. Forrest, Mr. A. Sym and Mr. R. Sym, trading as Forrest & Sym, ironfounders and engineers, Manchester, we are informed that Mr W. E. Gunthorpe has severed his connection with the firm and that the business is being carried on as before under the same title by the three remaining partners, Messrs. C. Forrest, A. Sym and R. Sym.

Discussion on Mr. George Mortimer's Paper on "The Die-Casting of Aluminium Alloys."*

DR. R. S. HUTTON said that in many cases the pressure in pressure die castings was only sufficient to squirt or shoot the metal into the mould, the pressure applied during solidification being immeasurable and uncertain, and not maintained for a sufficiently long period. We were looking for the development of methods of a general type, for general application, by which the pressure could be maintained during solidification.

MR. S. L. ARCHBUTT said there were undoubtedly great possibilities in aluminium alloy die-casting from the point of view of the properties obtainable in the castings for engineering purposes. The properties of heat-treatable alloys particularly should approach those of forgings. It was evident that there was something unsatisfactory and uncertain about pressure castings produced under gas pressure, bound up with the overcoming of crystallisation, shrinkage and absorption of gas, and he asked if these could be overcome by using a gas such as nitrogen, which was comparatively insoluble in the alloys. Could we cope with crystallisation shrinkage by using pressure? Perhaps, if a suitable material could be found, the application of pressure by a plunger rather than by gas would be possible. He also asked if there were possibilities of improving the properties of the castings by actually squeezing them when they were setting, so as to work the metal; it seemed a little doubtful that that would be possible. The presentation of such a Paper was an indication that the old spirit of the jealous guarding of trade secrets was passing, and that a spirit of co-operation among manufacturers, for the good of industry as a whole, was taking its place.

Low Temperature Annealing for Removing Casting Stresses.

DR. F. JOHNSON, referring to the action of molten aluminium on the material of the die, asked whether zinc melted with the aluminium increased or aggravated this action. With regard to the illustration of the gating of a simple hollow cylinder to provide lateral flow of metal over the solidifying portions of the casting (Fig. 11), he asked whether the riser on the left of the cylinder was of the same cross-section as the gate, and, if so, whether that was necessary, because it hardly appeared that feeding would take place through such a narrow runner. He did not know whether it had been found that effective feeding was obtained with a riser, or, for that matter, with the gate. Also, he asked whether, in this method of running, any defect occurred through the meeting of two streams of metal coming from one point of the circumference of the cylinder. The author had said nothing at all about low-temperature annealing for the purpose of removing internal stresses; he wondered whether, in certain cases, it had been tried, and whether it was likely to prove a commercially-suitable treatment. He had tried the Cothias process of casting, in principle, on a small scale, with brass castings, and considered there were possibilities in its application to other alloys as well as aluminium. Very great care had to be taken to obtain clean metal, but it seemed to him that one could get the advantages of chill castings, cast under pressure, which would rival the properties of a forging, or very nearly so, and, in any case, the small inferiority in properties would be more than offset by the gain in cost.

DR. WALTER ROSENHAIN, F.R.S., referring to nomenclature, said the expression "die-casting" was now used indiscriminately for pressure and gravity casting, and was really nothing more nor less than casting in permanent moulds. It was a pity that the name had been used in that way, and it would be better if we could arrive at an understanding as to exactly how the term should be used; he suggested that it would be an advantage to restrict it to pressure casting, and ordinary casting in permanent moulds should be termed "chill casting."

Crystallisation Shrinkage of Aluminium Alloys.

When one made an attempt to measure crystalline shrinkage by casting a bar in a sand mould between the faces of a steel template, say, one obtained a figure for total shrinkage which, on the face of it, looked like being a perfectly sound and correct figure. When one did that with a large number of alloys one found that the differences between them were surprisingly small. Yet one knew that the foundry behaviour of these alloys was not the same, and that they differed from one another. He suggested that that difference was not due to total shrinkage, but was largely a question of exactly when and how that shrinkage occurred. If one had an alloy with a short freezing range, it must take place very rapidly, but in an alloy with a long freezing range something different might occur. For instance, a skeleton structure might be formed occupying roughly the space of the whole casting, and its residual liquor would drain away, leaving a large amount of porosity. If one measured the shrinkage of a casting formed between the faces of a steel template, however, one did not find that kind of contraction, yet it was a very real contraction, and he considered that the only way was to make determinations of total contraction in the manner he had indicated, and combine them with the determination of density of the resulting casting. It was only when one succeeded in getting the casting to normal density that one could get an overall figure for contraction of that kind. In the great majority of cases the full density which the material ought to possess under normal conditions, or could be got to possess, was not obtained. But it was interesting and very valuable to have a record of the behaviour of different alloys from the foundry point of view, because there, when casting in permanent moulds, one had to deal with the overall effect of both these things. The ideal alloy was that which did not contract at all, but he was afraid we should not get that in connection with aluminium alloys. He would like a definite statement as to the relative foundry behaviour of the various foundry cast alloys. The question of the soundness of castings which were solidified in a metal mould was a very wide one, and the rate at which the metal was introduced into the mould was only one of the factors affecting it. The ratio of the rate of solidification and the rate of inflow of metal was very important, and possibly *the* most important factor; it affected not only the manner in which the casting solidified, *i.e.*, the order in which the various parts became solid, and therefore, the localisation of shrinkage, but it also affected the liberation of gas. There was liberation of gas in a chill casting. As the result of bubbling nitrogen through molten alloys before casting, it had been found that the density of a simple 1 in. chill bar could be very materially increased by treatment which tended to reduce the gas content, though formerly it was thought that in a 1 in. chill bar there was no unsoundness due to gas. Apparently there was. If that were the case, probably all metals contained a good deal of gas voids; if we could reduce them we were going a long way towards improving the product, and he considered that that was the path we should have to take. Certainly the question of diminishing the exposure of molten metal to gas under pressure and air under pressure was a matter of very serious importance. Whether the use of nitrogen, which was comparatively insoluble, would get over that, remained to be proved, but it might be necessary to interpose something, such as a plunger or a layer of other metal or something else, to reduce the pressure effect of gas in the metal. The squeezing of metal during solidification had been tried in steel, he believed with very little success; it did mighty little good. The only process which really did good appeared to be one in which the steel was forced under pressure into a conical ingot mould, so that it was, to a small extent, wire-drawn during solidification. The Harmet process, however, produced desirable properties, although

* This Paper has appeared in our last two issues.

it was expensive. But it was a different thing to apply these methods to aluminium alloys. The majority of them, when hot, were not only weak, but brittle, and if serious deformation were produced in them just when solidifying, he believed they would be damaged rather than improved. The whole effect of using pressure could only be, at best, to diminish the size of gas bubbles; it might conceivably suppress them altogether, but it would have to be enormously high. Whether or not pressure would do anything more than produce a rather better feeding of metal to make up for the crystallising contraction, he considered was very doubtful.

DR. HAROLD MOORE, O.B.E. (Research Department, Woolwich) said the comparison between pressure casting and gravity casting was particularly interesting, and the fact that the pressure casting gave the more unsound casting was very important. Mr. Mortimer had given the reasons for that very completely and adequately. The real problem in die-casting was to secure soundness. Dimensions, surface and mechanical properties were all very important, but we could deal with those, and when we could secure soundness with certainty in die-casting our troubles would be largely at an end.

Attack of Aluminium on Dies.

DR. J. W. JENKINS, referring to the emphasis which the author had laid on the necessity, in the case of a gravity mould, for the casting to freeze more or less progressively as the mould filled, and for each layer, as it froze, to be automatically fed by the fluid layer above, asked whether he regarded that as essential. In his own experience it had occasionally been noticeable that he could fill a mould, and yet the design of the gate and so on had been such that the metal had reached the gate before it was completely solid at the other ends of the casting; *i.e.*, strictly speaking, he did not get the condition in which each layer froze and was fed by the layer next to it. It was progressive freezing, certainly, but was it really essential to feed so slowly that the fluid layer was a little in advance of the solid layer? With regard to the pre-heating of moulds, the author had suggested the possible ranges of 250 and 450 deg. C. It might be necessary, in some cases, even to have a higher temperature than 450 deg., and he asked whether the author would regard that as detrimental in any other respect than the life of the die. As to the statement that, in pressure casting, metallic plungers were gradually abandoned in favour of one of compressed air, apparently they were abandoned because of the attack of the molten aluminium on the material of the plungers. It would be interesting to know whether, in present-day practice, the material of the containers for pressure die-casting was also attacked. If the plungers were attacked by aluminium, it was a matter of some difficulty to find a suitable material for the container itself, because that must be under pressure, and subject to the action of molten aluminium.

AUTHOR'S REPLY.

MR. MORTIMER, replying to the discussion, regarded Mr. Archbutt's suggestion of the use of nitrogen for pressure as a very practical one, but he did not know that it had ever been used. The reverse had been used, however, there being a vacuum to the die, and the metal being sucked in. As to the application of pressure after casting, honestly he considered it would be necessary to approach something like extrusion pressure, and, that being the case, one would have to use extrusion temperature also, otherwise the casting might be damaged, as Dr. Rosehain had pointed out. In any case, when working with pressures such as that, one would have to use a very costly type of die, and it would probably not be worth it, because the whole idea of die-casting was to produce castings as rapidly and as cheaply as possible. He did not think there was any appreciable difference in the action of molten aluminium on iron by the addition of zinc. It did not seem to vary whether one used the British standard specification copper alloy, pure aluminium, or L5, which latter contained zinc and copper. He had never noticed any difference in the action of different alloys on pots, probably because one was very careful in dressing the pots. The main loss fell mainly on the outside, owing to the action of various gases.

Risers not Feeders in Die Castings.

In reply to Dr. Johnson, he said that the riser was of the same section as the gate in the illustration referred to. It was generally made reversible, so that one could pour in one direction or the other, and there was very little feeding action. One did not regard that riser as a feeder. The main reason for the riser was to equalise the temperature conditions in the casting. If one side of a casting were heated more than another, good results could not be expected, and the object of the gate was to allow the mould to be filled very gradually, so that when the metal was about half way up, the bottom of the casting had set, and he tried to maintain those conditions right to the top. It might be asked what happened to the top. Generally there was a false top, which was cut off, and it contained the blowholes and dust, and other impurities.

Annealing for the purpose of removing stresses was carried out a great deal. It was almost universal in the case of one of the biggest fields for permanent mould castings, namely, pistons, but when making small telephone or typewriter parts, which must be very accurate, inasmuch as annealing to remove stresses also distorted the castings, the great thing was not to have stresses in the castings to start with.

He concurred with the remarks of Dr. Rosenhain as to the indiscriminate use of the term "die casting," and said that if one referred to permanent mould casting as die-casting in America, they would go mad. Die-casting, in America, was pressure casting, but in this country it might mean anything. The use of the term "chill casting," however, would also lead to confusion.

Crystalline Shrinkage.

As to crystallisation shrinkage, Anderson had given the shrinkage of No. 12 alloy as about 3½ per cent. in cooling from 1,000 to 700 deg. C.; that was a shrinkage of about 1 per cent. per 100 deg. He had also given the crystallisation shrinkage of the same alloy as 7 per cent., and, generally speaking, that was about the percentage one observed in practice. A 7 per cent. volume shrinkage in the interval between the liquid and solid state was fairly abrupt, and that was why it was so difficult to deal with. When it occurred at a point, instead of over a range, as in some of the silicon alloys, in which one got right on to the eutectic point, in casting a thick section one was almost bound to get a big cavity in the centre, because the total contraction, by volume, due to crystallisation shrinkage, took place abruptly, and in those cases extraordinary cavities could be produced. He had seen cavities in those, and in the 33 per cent. copper alloy, in which one could put a fist, though the cavities were quite clean. The great thing was to get slightly off the eutectic point; otherwise, the view room should have a pair of scales, in order to weigh the castings before passing them out.

Progressive freezing was not actually essential, but if one could impress upon one's whole staff the desirability of that progressive freezing, it was bound to lead to better results. He quite agreed that it need not be carried to undue length. It was almost impossible, with some castings, to follow out that principle, but it was a very good principle to concentrate upon in designing the gate. It was essential if the very best results were to be obtained. Although Dr. Jenkins had said that his mould was filled before the metal had started setting at the bottom, there was, at the same time, progressive freezing, and if there were not he would find the difference. There was nothing detrimental about raising the temperature of the die. In some cases he had run dies nearly red hot, and considered it very good practice, especially for crank cases and highly stressed parts. The die did not last so long, but that was not expected. The containers used in pressure casting were attacked by the molten aluminium, but not to the same extent as the plungers.

Foundry Delivery and Output.

By W. J. Hiscox.

Delivery and output are often in conflict, for, contrary to the belief of a great many people, the two terms do not mean the same thing. The word "delivery" is associated with orders where a delivery date is specifically mentioned, and is an integral factor of the contract; while "output" denotes the mass of completed work leaving a department, or a factory, during a specified period.

For example, an order is accepted for 500 castings, these to be delivered at the rate of fifty per week, commencing two weeks from the date of the order; or an order is accepted for ten castings, these to be completed and delivered by January 30. These are examples of "delivery." On the other hand, the foundry produces 30 tons of castings per week; this is output.

A foundry, whether attached to an engineering factory and engaged exclusively in producing castings for that factory, or acting as an independent concern, catering for the requirements of a number of engineering works, is vitally concerned with the conflicting claims of delivery and output, and must give due consideration to each. It is not enough to concentrate upon the question of delivery because in this case output is almost bound to suffer, whilst, if output is the sole aim and object of the foundry manager, it is certain that there will be many complaints from customers because promised deliveries have not been kept.

To ensure the foundry being a paying proposition, the weekly output must not fall below a certain figure, otherwise the working costs are out of proportion to the value of the product. This particularly applies where the foundry is being run on a "tonnage basis," but it is not obviated even where the "price per piece" operates, although the importance is minimised. As, however, the "tonnage basis" rules in the majority of foundries to-day, we must, for the purposes of this article, deal with the matter from this aspect.

It may be taken for granted that the average foundry foreman is primarily concerned with output—not only because the management are actively interested in this, but because, by getting the required output, he is automatically putting himself right in the matter of working costs. Delivery, on the other hand, means a deal more trouble, for not only is there the probability of output being adversely affected, but the still greater probability of enhanced costs, which brings down upon his head the wrath of the management. It is small wonder, therefore, that he takes the easy line of resistance; if there is to be trouble, let it be in connection with delivery, which is a minor matter in comparison with output and cost.

That this attitude ultimately brings about the state of affairs he wishes to avoid is not always apparent to the foreman, and yet it is obvious that sooner or later delivery will assume a paramount position, to the discomfiture of output and cost. So sure as delivery is neglected, there will come a time when the clamour of customers can no longer be ignored, and, no matter what may be the effect upon output and cost, the most urgent delivery orders must receive priority.

Once the claims of both output and delivery

REQUIREMENT SCHEDULE.

Week Ending _____

Order Number.	Pattern Number.	Quantity Required.	Quantity Cast.	Weight.	Wasters.	Weight.

Fig 1.

ARREARS SHEET.

Week Ending _____

Order Number.	Pattern Number.	Quantity Required.	Quantity Cast.	Wasters.	Quantity Deficient.	Reasons.

Fig. 2.

XUM

are recognised by the foundry management, steps can be taken to give them equal consideration. If deliveries are planned in conjunction with output, it is not really difficult to satisfy the demands of customers without reducing the tonnage output, and without increasing the cost of production. It is unpreparedness that causes trouble, and when the rush comes, the organisation is unable to cope with it, and the officials are swept off their feet.

If the foundry manager knows, not only what weekly tonnage output is expected of him, but also what that output is to be comprised of, his task is simplified because, knowing just what is wanted, he can plan ahead. The unexpected is, therefore, eliminated, and the sudden rush does not materialise. There are, of course, times when a "speeding up" is necessary, but this obtains in every foundry and in every factory, no matter how well organised; this is not the same, however, as the complete reversal of policy which temporarily throws everything out of gear, piles up the expense, and creates a turmoil which is not allayed until long after the cause has ceased to exist.

A simple expedient was inaugurated by one foundry, with a view to reconciling the interests of delivery and output, and, on the whole, it worked very well. It was really based upon a scheme operating in a foundry attached to an engineering works, where every week the planning department issued to the foundry a schedule of the castings required by the machinery department during that week. This idea was adapted to serve the needs of customers' orders, and every Monday morning a new schedule emanated from the foundry office, giving particulars of the requirements for the week.

The items were arranged in order of priority from a delivery standpoint, but the quantities covered by the schedule did not, as a rule, approach the aggregate tonnage capacity, so that there was always an opportunity for the foundry to "make good" on heavy work after the most important deliveries had been met. The schedule was prepared from data furnished by the sales department, and a copy was sent to each responsible foreman. Figures were inserted under the headings of "Order Number," "Pattern Number," and "Quantity Required," in the first instance, but the figures relating to the quantity cast, weight, and wasters were inserted by the booking clerk under the direction of the castings inspector. The schedule is illustrated by Fig. 1.

It will be appreciated that it was not possible in every instance for the requirement to be met, but, as there can be no defection without a reason, a reason had to be given by the officials concerned. This was entered upon an arrears sheet (see Fig. 2), and, whenever the quantity of castings passing the inspector was below the requirement as stated upon the schedule, the reason had to be given upon the arrears sheet. Responsibility for compiling this sheet rested with the head foreman, who, in the foundry under review, acted as under-manager, and he had to submit the completed sheet to the foundry manager before it was passed to the sales office. This sheet had the effect of keeping the foreman up to the mark, for nothing a foreman dislikes so much as having to record the reason a certain thing is not done.

The schedule and the arrears sheet had to be sent to the foundry office on Friday evening, and by that time the office was in possession of data from the sales office relating to the following week's requirement. Forthwith a new schedule was compiled, the requirement being supplemented with the arrears of the preceding week, and this was ready for issuing to the foundry on the following Monday morning. After being dealt with in the office, the completed schedule and arrears sheet were sent to the sales office, and any outstanding feature was subsequently debated by the sales manager and the foundry manager.

The scheme had the merit of keeping before each foundry official the commitments of the firm, and in such a way as to ensure each individual knowing just how far he was personally involved. There was no question of an unexpected demand upsetting all planning and calculations, for urgent orders were given due prominence, long before the position became desperate. The scheme also acted as a curb upon the sales office, for no eleventh hour rushes could be introduced into the foundry unless the order in question appeared upon the schedule. On the other hand, the foundry officials were debarred from filling the store with unwanted castings, while more urgently wanted orders were untouched, just to bring up the tonnage output. There was no merit in such a proceeding, and gradually the organisation was strengthened to ensure that, while the tonnage output was reached, the delivery claims of individual orders were catered for, which satisfied the customer, the sales office, and the management.

Export of Scrap from France.

New Regulations.

The conferences between representatives of the Government, the Comité des Forges and the scrap-iron dealers have now led to an agreement. New regulations relating to the export of scrap iron will come into force on February 1 of this year. Although no official notification has, as yet, been issued, there is reason to believe that the broad lines of the scheme will be as as follows, according to "L'Usine":—

Exports of scrap will be restricted to two comptoirs, of which one will be under the jurisdiction of the Comité des Forges, which will deal with wasters of blooms, billets, and steel-foundry scrap. The other comptoir will be under the direction of a committee of scrap dealers, and will deal with all other kinds of scrap steel and old castings. The latter committee will comprise members appointed by the different districts interested in this trade. The French Government will make quarterly allotments to foreign Governments in want of scrap, and issue the permits for quantities allocated to them. These foreign Governments will then re-distribute the tonnages allotted to them at their own discretion among the industries concerned in their respective countries. Permits will only be granted to licensed dealers, who purchase scrap for export.

With reference to the Scrap Dealers' Comptoir, it is understood that a fee of 10 centimes per ton must accompany every application for the export of each consignment, in order to cover the service expenses incurred. The Comptoirs must, at the end of every quarter, notify the Customs authorities of the transactions completed.

The reason why the permits are to be sent to the Governments of the respective countries for redistribution is that the Italian Government wishes to ensure that supplies should be maintained to firms working for that Government.

The export of scrap from shipbreakers' yards remains free, but, in order to pass the Customs, shipbreakers must obtain a permit from the Scrap Dealers' Comptoir. These permits will be issued without limitations of tonnage upon the production of clear evidence as to the source of the scrap.

The preliminary discussions were presided over by M. Serruys, Director of Commercial Agreements at the Ministry of Commerce, and M. Guillaume, Director of Mines at the Ministry of Public Works. The representatives of the Comité des Forges were associated with M. Dufour, President of the Foundrymen's Syndicate.

These new regulations will be subject to revision at the will of the authorities concerned. Up to the present the quantity of scrap that may be exported remains unaltered at 120,000 tons per annum. The usual dealers will now find their tonnage reduced, since the export of certain classes of scrap (wasters of blooms and billets, and steel-foundry scrap) has been forbidden. The permits recently issued for these classes totalled 12,000 tons of such materials at the disposal of the Comptoir.

A New German Steel.—The Berliner A.G. für Eisengiesserei und Maschinenbau is reported to be producing a new description of steel, having an ultimate tensile strength of 53.3 kg. per sq. mm. (about 34 tons per sq. in.), with an elongation of 44.1 per cent. on the standard test piece.

Aluminium-Alloy Permanent-Mould Castings.—V.

By Robert J. Anderson, B.Sc., Met.E., D.Sc.*

Aluminium-alloy permanent-mould castings may have relatively great accuracy as regards size of successive pieces. However, permanent-mould-castings producers are not agreed as to the size tolerances which should be specified. Usually, the weight of successive pieces is very close. Some manufacturers believe that it is a mistake to guarantee very close limits, i.e., to the extent that die casters guarantee limits, while others claim that permanent-mould castings can be made in regular production to size tolerances as close as die castings. The writer is of the opinion that it is a mistake to insist that the permanent-mould process ensures precision castings, and believes it is preferable to talk about limits in 64ths of an inch for these castings, rather than in thousandths of an inch, as is the case with die castings. The first few castings run off a permanent mould may be very close (within a few thousandths of an inch) to given dimensions, but changes in the size and shape of the mould and cores with repeated use naturally causes variations in the dimensions of the castings.

Sizes and Size Tolerances.

Aluminium-alloy permanent-mould castings are made in sizes from, say, an inch long (or in largest dimension) up to, say, 12 or more inches long. The smaller sizes of crankcases have been cast in permanent moulds using sand cores.

Regarding size tolerances or limits in dimensions, some manufacturers believe that the size tolerance should be about ± 0.025 in. on a small casting, and an allowance of from $\frac{1}{32}$ to $\frac{1}{16}$ in. for finish on comparatively large pieces. These manufacturers claim that the permanent-mould method is not a precision process, and believe that wherever very accurate dimensions are called for the castings should be machined. Some manufacturers guarantee size tolerances where required to ± 0.01 in. and the diameter of cored holes to 0.01 in. with a minimum taper of 1½ deg. included angle (2 deg. preferred). These manufacturers do not feel that there is any great advantage in trying to hold permanent-mould castings to precise dimensions, for the reason that they cannot secure a sufficiently great accuracy to permit the use of a casting without machining when the part must make a fit with another part. While machining is often unnecessary with permanent-mould castings, it is felt that the real advantage in the use of these castings with closer tolerances than sand castings lies in the fact that all permanent-mould castings require less finish allowance for machining than sand castings, and that they fit jigs and machining fixtures readily, and hence make the finishing problem of the consumer easier. One producer of castings will not guarantee size tolerances except for the fitting of jigs in machining operations. This producer has made some parts with guaranteed tolerances of 0.005 in., but considers 0.01 in. the limit, and prefers to ask for $\frac{1}{32}$ in. Size tolerances have so far not been a matter of concern in the production of pistons, since these castings are all machined and ground.

In contrast to the feeling of most manufacturers as given above, one producer of permanent-mould castings will guarantee the size (and also weight) of any casting undertaken within very narrow limits, e.g., ± 0.0015 in. on a 1-in. diameter or length. This manufacturer aims to make castings to very close limits in competition with die castings for interchangeable parts. This manufacturer finds that 0.007 in. on the principal dimensions is ample, and that a draft of 0.007 in. per inch of diameter and length on round cores is sufficient. These limits, however, are said to have been reduced in many instances. The smallest size of hole recommended is $\frac{1}{16}$ in., with $\frac{1}{8}$-in. thick for the thinnest section on small castings and $\frac{5}{32}$ in. on larger ones.

Speaking generally, unless a casting is small and of simple design, difficulty may be encountered in holding to close size limits, owing to uneven contraction caused by variation in sizes of contiguous sections and trouble in feeding such sections. When machining is to be done on a part, the limits usually suggested for finish are $\frac{1}{32}$ to $\frac{1}{16}$ in. Long cored holes are given a slight taper which can be straightened by reaming. The general size accuracy may be taken as ± 0.01 in., with minimum wall section of $\frac{1}{8}$ in. In comparing the accuracy of die, sand, and permanent-mould castings, size tolerances of die castings are usually given in thousandths of an inch, those of sand castings in eighths and sixteenths of an inch, and those of permanent-mould castings in hundredths and thirty-seconds or sixty-fourths. In any case, the limits of dimensions are dependent considerably upon the size and shape of the casting.

Weights and Weight Tolerances.

Since the art of permanent-mould casting for volume production is comparatively new, most of the production in the past has been confined to parts of which the average weight did not exceed 2 lbs., but with recent developments a number of parts are now being run in production with weight varying in the range 5 to 15 lb. The minimum weight of castings produced is about ½ oz., and the maximum 25 lb.; crankcases weighing 100 lb. have been produced by the semi-permanent-mould process. American manufacturers are expecting to produce castings weighing more than 25 lb. by permanent moulding, using steel cores, in the near future. With steel cores, at the present time, the heavier castings should not present too great complexity of design, but with the developments made in mechanically operated moulds, mechanical removal of cores, and mechanical ejection of the castings, there seems to be no reason why heavy castings cannot be produced

It might be thought that very small parts, e.g., those weighing ½ to 1 oz., could not be made in permanent moulds in competition with die castings. This is, however, possible where the number of parts required does not warrant the expense of making a die but would warrant the expense of making a mould, and also where the mechanical properties are of importance.

At the present stage of development, the permanent-mould process is ideally adapted for making castings weighing ½ to 2 lb., and so far the bulk of the production has been in castings weighing in this range. Pistons weigh ½ to 3 lb., with an average weight of about 1¾ lb.

Regarding weight tolerances, some producers have never been asked to guarantee specific weights, while others feel that a 2 per cent. variation on the weight should be permissible. One producer guarantees the weight of castings to the extent that all parts which weigh more than a set weight as laid down by the producer will be replaced. Weight tolerances are a matter of some concern to piston manufacturers. Weight limits vary depending upon the size, shape and weight of the casting, and the weight tolerance is usually ± 1 or ± 2 per cent.

* Consulting Metallurgical Engineer, Cleveland, Ohio, U.S.A.

New Companies.

Clarke Construction Company, Limited, 32, Gresham Street, London, E.C.2.—Capital £1,000 in £1 shares. Constructional, contracting and general engineers, etc. Directors: B. B. Clarke and W. E. Radford.

Holden's Drop Forgings Company, Limited, Dial Lane, West Bromwich.—Capital £3,000 in £1 shares. Directors: C. V. James and W. E. James.

Hopkinsons, Limited.—Capital £700,000 in £1 shares (350,000 preference and 350,000 ordinary). Boiler makers. Directors: R. A. Hopkinson, 36, York Place, Harrogate; E. W. Craumond, N. H. Docker, and five others.

The Selling of Castings.—XXVII.

By Voyageur.

A few words must be said on the interesting matter of what literature should be used for exhibitions before this series, now nearing its end, becomes complete. In the first place, the founder has to bear in mind that literature for exhibitions demands dissimilar treatment from that given to sales literature of the familiar kind. There is one cardinal point of difference between exhibition literature and ordinary sales literature. The latter is written for the person who, it is reasonable to assume, has never set eyes on the castings, or at least on a particular founder's castings. The former, on the other hand, is designed for the person who, while at the exhibition, is actually looking at the castings, and wants to obtain further information in their regard. It should be apparent, if the remarks given in earlier articles have been thoroughly grasped, that a widely different method and style must be adopted for each. They are not interchangeable.

Literature intended for use at exhibitions should pay attention not so much to what the castings *are* or *consist of*, as to what they *can do* and *save*. The main reason why it is a mistake to employ ordinary sales literature for exhibitions is that in this instance sales literature is written from the wrong point of view. Therefore, it cannot be so persuasive and powerful in its appeal as the literature specially written to attract the visitor to an exhibition. Sales literature is not aimed at any one class of buyer. It is designed to appeal to them all, and its wording is usually impersonal in character. While no doubt invaluable for general purposes, it is likely to lack weight when used for a special purpose. It is too aloof and formal to be enjoyed by the man who has carried it away from an exhibition stall in order to read it at his convenience. It does not connect his visit intimately enough with the castings and their producers. The literature expressly written for exhibition purposes, on the other hand, is, if it is properly designed, full of personal appeal. Its purpose is to remind the reader strongly of the goods he has seen at a particular stand. It says to him from paragraph to paragraph: "You will recall seeing this," and "You saw that yourself." Because it compels the reader to exercise his memory, and refreshes that which it exercises, it is more enjoyable than a conventional sales booklet that has no such appeal.

In designing exhibition literature, care should be taken to avoid booklets of too heavy and voluminous a character. These become a nuisance to the visitor after he has carried them for an hour or more, and are apt to be left behind in restaurants or trains, if not actually dropped quietly in some part of the exhibition itself. Exhibition literature should not be so costly in format that it cannot be given away in fairly large quantities. It should be smaller and lighter than the ordinary sales literature, and, for preference, of pocket size.

At the same time, the writer dislikes the practice of handing out good literature lavishly to all and sundry at exhibitions. Assuming that its cost has been within reasonable limits, there is no reason why applicants for exhibition literature should be regarded with hostility, but to force upon visitors, children, school teachers, and any miscellaneous passers-by brochures and folders in which they have only a momentary interest is merely to waste that which has cost many hours and much money to produce. The littered floors of exhibitions are testimony enough to the waste that goes on. It should be a rule that literature should only be given out on request. Standard catalogues and booklets should not be given out at the exhibition at all. Any person who really requires them should be asked to give his name and address, so that copies may be posted to him from the foundry or foundry offices. The advantage of this is that the founder can then follow up the visit, and perhaps secure orders. It is, perhaps, advisable to keep just one set of the ordinary literature at the stand for consultation by the attendant.

Following Up Exhibition Inquiries.

It must be clearly understood that, although the stand may be well planned, the stand attendants competent and tactful, the exhibition literature attractive and handsome, an exhibition only brings business to the founder who makes efforts to get it. Certain steps to this end must be taken before the exhibition actually begins. Letters of invitation should be issued to every possible or actual customer, both in this country and in those overseas countries that are likely to visit the exhibition. Conventional letters and invitation cards are useless. A good plan is to let the invitation card carry a plan of the exhibition, showing where the stand is placed, so that the customer can slip this card into his pocket and use it as a guide when occasion offers. In addition, the card might carry a short account of the castings that are being displayed. It is sometimes worth while to enclose with the card of invitation a stamped, addressed reply card, so that the customer can notify the founder of the potential date of his visit, and of the kind of castings in which he is especially interested.

Calls will be made from time to time at the stand itself, and the task of the attendants is to report these calls to the head office, with the names and addresses of the callers wherever possible. When the exhibition is over, the founder will find it a good plan to send something in the way of a special souvenir or reminder to all these callers, so that they will have something by which to remember his stand and its contents—one founder, for instance, published a special exhibition number of his monthly house organ. The souvenir should contain a description of the stand and all that it contained, with illustrations. The visitor who discovers one of these souvenirs in his morning's post will examine it with interest, if only because it brings back to him memories of what he has seen. Some firms send out these souvenirs to their customers before the exhibition has actually run its course, the idea being that they may be tempted thereby to visit a stand they would otherwise have neglected.

The list of callers at an exhibition stand constitutes a useful supplement to the regular mailing list. The names it contains are those of persons who have given evidence of interest in the castings, though in actual cash value of orders received or receivable from them they may vary enormously. The regular travellers should be notified of all the more important visits, so that they may get into touch with the firms represented. If a house organ exists, it might with advantage be sent regularly to the recorded visitors, so that they may be constantly reminded of the firm whose stand they once inspected.

But beyond all these plans, there lies the greater plan of following up these visitors consistently. A series of good sales letters should be prepared, three at least, but not more than five in all. They should follow each other at regular intervals, according to the time taken for each letter to reach the recipient, and for a reply to be received. These letters must be written carefully and tactfully. They should carry an enclosure—if not the souvenir booklet, something equivalent. They should strive to draw an answer. Their tone may be a little warmer than in ordinary business letters, though, of course, it should never approach familiarity. The caller should be made to feel as if he were a welcome guest who has left behind him charming memories.

The salesmanship in these follow-up letters should be efficient without being spectacular. No attempt should be made to pester the caller into sending orders, yet opportunity should be taken to press home the main features of the castings. Every letter should take a different selling point or aspect of the subject, and none should be merely repetitive. The first, for example, may enclose a booklet; the second, photographs of the factory; the third, a striking testimonial; the fourth, a trial order form; and so on. Carefully followed up in this manner, the exhibition may become a most important and valuable means of selling more castings.

In the next article the writer will discuss overseas selling, as it affects castings.

Institute of British Foundrymen.

BRANCH DINNER AT BIRMINGHAM.

The President of the Institute of British Foundrymen (Mr. John Cameron), Mr. V. C. Faulkner, Professor Turner, Mr. V. Delport, and Mr. J. T. Goodwin were among the guests of the Birmingham, Coventry and West Midlands Branch at their annual dinner, held at the Engineers' Club, Waterloo Street, Birmingham, on Saturday night, March 13. The President of the Branch (Mr. D. H. Wood) was in the chair.

Growth of the Institute.

The toast of "The Institute" was proposed by PROF. T. TURNER, who spoke of the importance of the metal trades, not only to the Birmingham district and the country, but to civilisation generally. Without them it was a commonplace to say that civilisation as we knew it could not exist. The foundrymen's industry in its various branches was fundamental to the metal trades. In many cases the article was practically finished in its cast condition; in others the work of the foundryman was only a stage in the process. There were Guilds and Associations in years past in connection with the branch of work in which those present were interested. But circumstances changed, scientific knowledge became more and more important, and it was felt that they must follow in the steps of other trades and professions, like the mechanical and the civil engineers and so forth, and it was recognised that a foundrymen's association was required. The Americans were ahead of us in starting such an association, and he remembered being in Boston in 1902 when they were holding a conference in the early days of their organisation. The British organisation was founded some years later, but it had steadily grown in numbers and in importance, while by its publications, its general meetings, and its branches it was doing a great and useful work for the foundry industry. At first sight founding was very simple, but in order to apply apparently simple rules they were brought into contact with a great variety of subjects and an enormous amount of scientific and technical knowledge was required. The composition of the metals used, the methods of determining that composition, the changes that took place during melting, the furnaces employed, the blast and its pressure, and even the moisture in the blast, the materials of which the furnaces were built, the question of fluxes and slags, how to determine the shrinkage of the metal, the design of the patterns, especially when die casting and complicated shapes were concerned, the methods of testing the product—all these matters involved questions of chemistry and metallurgy and engineering and physics. When they had made the material, the next thing was to sell it. That was quite a problem, and even sometimes to get the money after they had sold the material. (Laughter.) So that there were branches outside the strictly scientific ambit of the subject which required the attention of foundrymen. The Institute provided for the collection and dissemination of knowledge, for bringing men in the industry into friendly contact, and by the Branches for giving an opportunity, to the young men particularly, to gain a further insight into the fundamental principles underlying their occupation, with the result that they not only derived pleasure from their studies, but became much more efficient in their work. It would be realised, therefore, that the Institute was well worthy of support. He associated the toast with the name of Mr. Cameron, the President of the Institute, whom he said they all welcomed, and acknowledged the valuable work which he had done for the progress of the organisation.

MR. JOHN CAMERON, in responding, said a meeting of the Council had been held during the day, and he had now practically ended his official duties as President. Being a Scot, it was a satisfaction to him that he had not missed a single invitation to dinner—(laughter)—and his only regret was that the East Midlands Branch only dined together once every two years. (Laughter.) He had been much gratified by the work accomplished by the Council during his term of office. He did not think that any President had had the support of a finer Council than he had. They had had to consider some exceedingly difficult and contentious matters, such as the alteration of Rule 18, but the spirit in which the Council—a body of men with strong individual opinions—tackled the problems and overcame them had been very satisfactory. He felt that his next official appearance would be at the London convention in June, when he would hand over the chain of office to his successor. He admitted that he had enjoyed his period in the presidential chair. It had entailed a great deal of time and travelling—out of the last six week-ends five had been spent away from home on Institute work, or at Institute functions—but at the same time it had been pleasant work and work which he enjoyed.

The toast of "The Kindred Associations, at Home and Abroad," was submitted by MR. D. WILKINSON. It was often remarked, he said, that associations, both scientific and otherwise, were multiplying with great rapidity to-day. He contended, however, that any organisation which devoted itself to the pursuit of knowledge and the furtherance of the general welfare of the human race deserved not only their support and sympathy, but their closest adherence.

The Detroit Convention.

MR. V. DELPORT, who replied, commented upon the interest which foundry organisations on the Continent were taking in each other's work, and said he was a firm believer in close relations between the technical associations of the different nations. He was convinced that it was a great benefit to foundrymen to know what was going on in other countries, and he was very pleased to know that the relations between the foundry organisations of the various countries were becoming more intimate. The Americans had taken a great part in fostering international relations between foundry organisations, and in connection with the American Foundrymen's Association there was a permanent committee on such relations. About 1920 the practice was begun of exchanging Papers at the annual convention on important foundry subjects. The idea had progressed immensely, and in the past five years Papers had been annually exchanged during the conventions between America, Great Britain, France and Belgium. He was certain that the idea would extend to other countries. That night he had a special message, namely, to reiterate the invitation of the American Foundrymen's Association, which was sent to the President of the Institute last November, to attend the second International Foundry Congress, which was to be held in Detroit from September 27 to October 1 of the present year, for which a comprehensive programme was being arranged.

In asking the company to drink the health of the guests, MR. F. J. COOK referred to Professor Turner's impending retirement, and assured him of the good wishes of foundrymen at home and abroad. He added that he had only one regret with regard to the visit to America—that it was not going to be one of Cook's personally conducted tours. (Laughter.) From his own experience in the States he assured any who might contemplate the visit that it would amply repay them.

MR. J. T. GOODWIN, in acknowledging the toast, said the British Cast Iron Research Association was moving at a rapid pace, and was being well backed up by the Institute of British Foundrymen. The Government was interested in the activities of the Research Association, and they had every hope of continued support during the next few years.

MR. V. C. FAULKNER, in submitting the toast of "The Birmingham, Coventry and West Midlands Branch," referred to the ownership of the official organ, which he said had recently been modified in its structure. Two of the old directors were retained. He had not yet had the pleasure of meeting the whole of his new directors, but those whose acquaintance he had already made were very charming people. They were promoting the interests of the Institute very enthusiastically, and he thought they might look forward to a continuation of the close association which had been established so long. There was a Government poster, Mr. Faulkner continued, which offered as an inducement to recruits that they might see the world at their country's expense. He advised them to join the I.B.F. and see the world at their own expense.

(Laughter.) At any rate, he wanted them to see a bit of the Empire in June, and that was London, and he assured them that no stone was being left unturned which would ensure that visitors had a good time. In associating the toast with the name of the President of the Birmingham Branch, Mr. Faulkner said that, like himself, Mr. Wood was attached to an industry allied with the foundry, the connection of which had recently been strengthened by a slight modification of the rules of the Institute.

The President of the Branch, who was very cordially greeted, reviewed the local work in the course of his response. The lectures, he said, with one exception, had been given by members of the Branch. Thanks to the generosity of a local firm, a room for the meetings had been placed at their disposal free of cost. Although at the commencement of the session they found themselves in a position of financial embarrassment, they closed the year not only solvent but almost in a position to declare a dividend. (Laughter.) During the year 36 new members had joined the Branch, in addition to which 10 members had been transferred. Against that had to be put loss by resignation, etc., but there was a net gain in membership of 28, and the total strength of the Branch was 200. During the year active steps had been taken towards the formation of a Junior Section, and a number of meetings had been held. Unfortunately the attendance had not been large, but at the last meeting there was an increase of over 100 per cent. in the attendance, so that the outlook of the Junior Section was brightening. He warmly acknowledged the assistance rendered to the Junior Section by Mr. F. J. Cook. Mr. Wood alluded to the inclusion of Coventry in the scope of the Branch, and paid a generous tribute to the services of the Hon. Secretary, Mr. H. J. Roe. He also spoke in appreciation of the work of the Branch Council. "I have been splendidly supported during my year of office," he concluded.

There was a varied programme of music and mirth.

Some Experiments on the Soft Soldering of Copper.*

By T. B. Crow, M.Sc., Ph.D.

(*Summary.*)

The Paper deals principally with the interfacial effects which arise between soft solder and copper when the latter is soldered under conditions which do not represent industrial practice, the author's contention being that the effects observed and recorded in a series of photo-micrographs are simply "enlargements" of those which would occur under industrial conditions; and that his method of experimenting is a convenient device for studying effects which may be ultra-microscopic under ordinary soldering conditions. The wide scope of the subject is indicated, and suggestions and criticism upon the many theoretical issues which it involves, and the difficulties attending a full investigation of the mechanism of soft soldering generally (as brought to light in this Paper, from work upon the soldering of copper) are invited.

The photo-micrographs show evidence of having been prepared with great care and should be of value in that they represent something new in this direction; the interfacial effects are most strikingly shown—a region which in many existing photo-micrographs is little more than an out-of-focus blur. A number of experiments upon matters which arose from a study of the micro-structure, viz.: (1) The solution of the copper by the "solder"; (2) the effect of pressure (applied during joining) upon the structure and mechanical properties; (3) the identification of the interfacial alloys is described.

The results of the experiments and of certain suppositions are summarised in a general theoretical résumé at the end of the Paper. References to relevant publications (including one of the author's, of which the present Paper forms a continuation) are given.

* A Paper presented to the Spring Meeting of the Institute of Metals.

Note on the Softening of Strain-Hardened Metals and its Relation to Creep.*

By R. W. Bailey.

(*Summary.*)

The author suggests that the creep of a metal under stress is the necessary accompaniment of the softening or reduction by thermal influence of a strain-hardened condition and its simultaneous recreation by further slip or strain. Thus, for example, it is suggested that under a given stress the rate of extension of a piece in tension is determined by the rate of softening, which in turn depends chiefly upon the temperature.

The softening characteristics of strain-hardened metals are examined, and it is shown that there is good reason to believe that generally the mechanism of softening is a definite characteristic of a metal uninfluenced by temperature except as to the rate of its progress, and further, that it takes place at all temperatures. It is shown that the law of softening is well represented by the relation:—

$$T = T_0 e^{-b\theta}$$

where T is the time to produce a given degree of softening at a temperature of θ deg. C.; T_0 is the corresponding softening time for a temperature of 0 deg. C.; b is a constant for a given material which ranges in value from 0.05 to 0.09 for the metals examined; and e is the base of the Napierian logarithms.

The author indicates that, neglecting the variation of the physical properties with temperature, which is of only secondary importance compared with the influence of temperature upon the rate of softening, a similar law would be expected to connect the life and temperature of a piece subjected to a given stress. It is stated that Dickenson's results support this deduction, and, consequently, if L is the life of a test piece at θ deg. C. and L_0 is the corresponding life at 0 deg. C., the relation between life and temperature is given by:—

$$L = L_0 e^{-b\theta}$$

The author finds that for the metals used Dickenson b has a value ranging from 0.046 to 0.07.

In questioning whether there is a limiting creep stress the author states that a critical examination of published data shows that in most cases the limit of accuracy of the apparatus or method used has been mistaken for such a stress.

The Determination of Zinc Oxide in Brass.*

By B. S. Evans, Ph.D., and H. F. Richards, B.Sc.

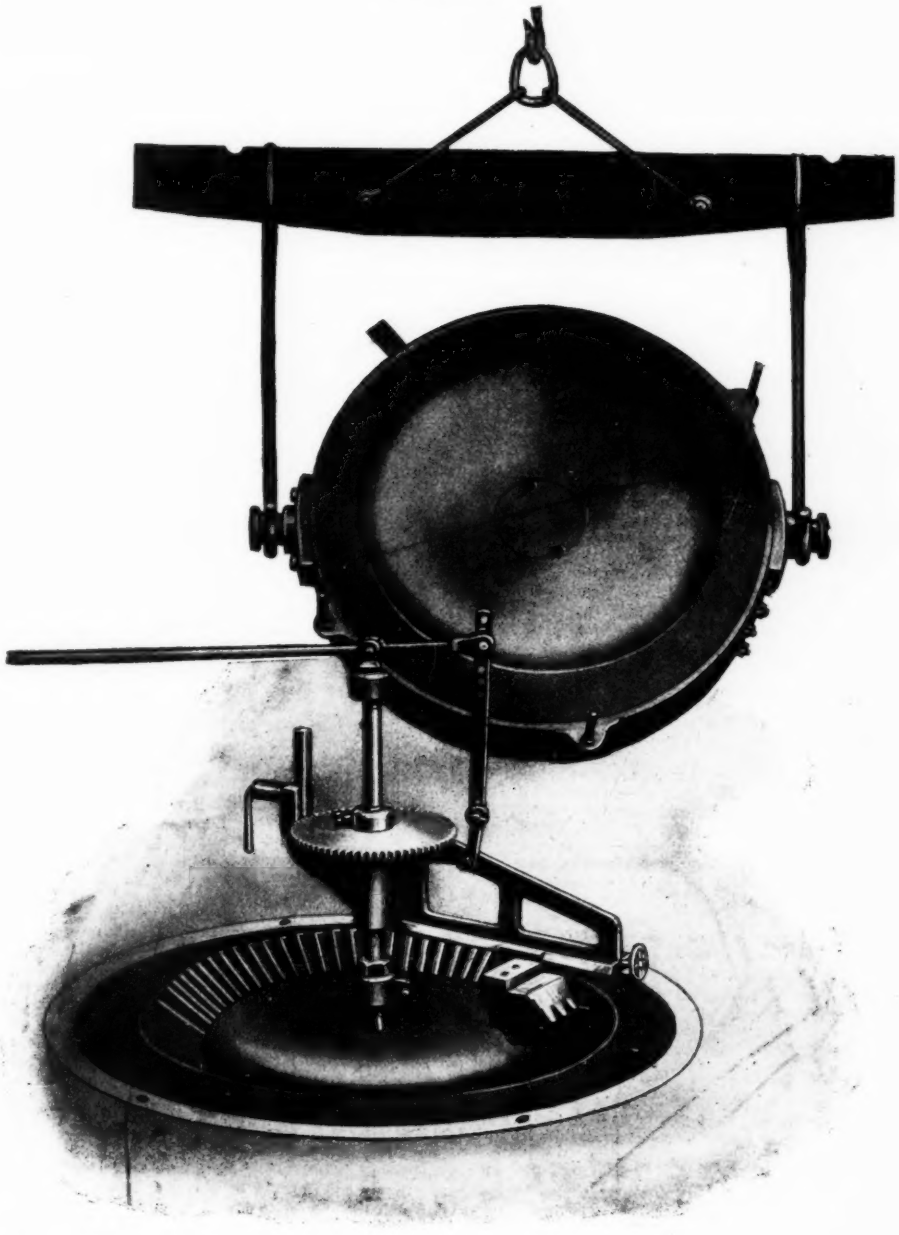
(*Summary.*)

A description of a method for the determination of zinc oxide in brass based on the fact that the back reaction $Zn + H_2O = ZnO + H_2$, which occurs when an attempt is made to estimate zinc oxide by Archbutt's method for estimation of oxygen in copper (Analyst, 1900, 25, 253), can be suppressed by the presence of sufficient copper to combine with the zinc volatilised from the sample. The estimation is carried out in the same apparatus and in much the same manner as for determination of oxygen in copper, but that part of the furnace tube which is not occupied by the boat is packed with tightly rolled copper gauze. The copper gauze is deoxidised by prolonged heating in a current of hydrogen, the furnace is then allowed to cool, the sample (a lump of about 80 grammes) introduced, the packing replaced, and after sweeping out the air with hydrogen, the furnace is heated up to 980 deg. C. and kept at this temperature until the rate of gain in weight of the phosphorus pentoxide U tube has dropped to that of a predetermined blank. The water evolved is estimated by the gain in weight of the phosphorus pentoxide U tube after deduction of the blank. Owing to the small amount of oxide which occurs in brass, somewhat elaborate precautions have to be taken to reduce the blank to a minimum; these involve additions to the purifying train and measurement of the amount of hydrogen passed.

* A Paper presented to the Spring Meeting of the Institute of Metals.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

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BLACKFRIARS, MANCHESTER.

Trade Talk.

THE FOUNDRY at the works of Robert Bowran & Company, Green Lane, Pelaw, was destroyed by fire on March 11.

AN ORDER for the construction of two cargo ships has been booked by John Readhead & Sons, Limited, South Shields.

THE BUSINESS of the Weir Tilt & Forge Company, Limited, Attercliffe, Sheffield, is being offered for sale by private treaty.

AN ORDER for a cargo steamer of 2,440 tons deadweight has been secured by S. P. Austin and Son, Sunderland, from the South Metropolitan Gas Company.

THE PATTERNS of F. Manby & Bro., Craven Ironworks, Skipton, have been purchased by the Yorkshire Range & Mantel Company, Limited, Prospect Foundry, Shipley.

THE CORDOBA CENTRAL RAILWAY, Argentina, has ordered 15 locomotives from the North British Locomotive Company, Limited, and 5 from Kitson & Company, Limited, Leeds.

MR. T. P. COLCLOUGH, of the Parkgate Iron and Steel Works, recently gave a lecture entitled "Modern Steel-making Methods" to the members of the Sheffield Metallurgical Association.

A LECTURE on the "Structure of Metals" was delivered by Dr. F. Rogers, of Sheffield, to the South Wales branch of the Institution of Mechanical Engineers, on March 11. Professor Frederic Bacon presided.

A LECTURE entitled "Some Notes on the Micro Structure of Permanent Magnet Steels—Tungsten, Chromium, and Cobalt," was given to the members of the Sheffield Metallurgical Association by Mr. J. C. Swan, recently.

THE NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, Springburn, Glasgow, are to supply 25 heavy goods engines to the London, Midland and Scottish Railway Company. This is in addition to the 60 tank locomotives under construction for the same railway.

JOSEPH COOK, SONS & COMPANY, LIMITED, Washington Iron Works, Washington Station, Co. Durham, have absorbed the Grange Iron Company, Limited, and the company's offices at Durham are now closed. All communications should in future be addressed to the Washington Works.

JOHN SUMMERS & SONS, LIMITED, have placed an order for two additional black sheet annealing furnaces, each 180 ft. long, and each having capacity for annealing 1,000 tons net weight of black sheets per week. This will make a total of three furnaces of this size and type installed at the works of John Summers & Sons, Limited, by the Incandescent Heat Company, Limited, Smethwick, Birmingham.

THE LONDON AND NORTH-EASTERN RAILWAY COMPANY announce that they have just placed orders with the following firms for 1,910 tons of steel fish plates:—Dorman, Long & Company, Limited, Middlesbrough; Cammell, Laird & Company, Limited, Sheffield; Bolckow, Vaughan & Company, Limited, Middlesbrough; Barrow Hematite Steel Company, Limited; Cargo Fleet Iron Company, Limited, Middlesbrough; and William Beardmore & Company, Limited, Glasgow.

MR. J. DUNCAN, liquidator of William Jacks & Company, Limited, states that his attention has been drawn to a circular issued by Parson & Crosland, Limited, Birmingham, in regard to the Birmingham business of William Jacks & Company, Limited. The whole goodwill of the company in liquidation, including the Birmingham branch, has been purchased from the liquidator by William Jacks & Company, of Winchester House, Old Broad Street, London, E.C.; 18, Bennetts Hill, Birmingham, and elsewhere, of which the partners are Mr. J. Gray Buchanan, Mr. Stewart Barry and Mr. R. Russell Walker. Parson & Crosland, Limited, although they have, with the consent of the liquidator and William Jacks & Company, London, taken over part of the office at 111, New Street, Birmingham, have no interest in the goodwill or business of the company in liquidation.

THE ANNUAL DINNER of the Institute of Metals was held last week in the Trocadero Restaurant, under the chairmanship of Sir John Dewrance (the president), who had the immediate support of the Right Hon. W. C. Bridgeman, M.P. (First Lord of the Admiralty), and Sir Alfred Mond, M.P. There were also present:—Professor T. Turner, Professor Sir Ernest Rutherford (president of the Royal Society), Vice-Admiral Sir Ernle Chatfield, Mr. A. J. Campbell (president of the Institution of Engineers and Shipbuilders), Sir Joseph Petavel (director of the National Physical Laboratory), Dr. W. Rosenhain, Professor W. H. Wagstaff, Mr. Barrington Hooper, C.B.E., Mr. H. F. Twentyman, Mr. H. H. Johnson, Mr. V. C. Faulkner, Mr. E. G. King, Engineer Vice-Admiral Sir Robert Dixon, Engineer Rear-Admiral W. M. Whayman, and Sir James Kemnal.

Obituary.

MR. J. A. GELTY, manager to Moorwoods, Limited, Harleston Iron Works, Sheffield, died last week at the age of 40.

MR. ROBERT HOBSON, president of the Steel Company of Canada, Limited, and a director of the American Iron and Steel Institute, died recently at the age of 65. Mr. Hobson played an active part in developing the Canadian steel industry, and formerly was president of the Canadian Manufacturers' Association. He held membership in the advisory council of scientific and industrial research of the American Institute of Mining and Metallurgical Engineers, and was a Fellow of the Royal Colonial Institute, London.

MR. J. ROSSITER HOYLE, J.P., a former managing director of Thomas Firth & Sons, Limited, Sheffield, died in London on March 14. Mr. Hoyle retired from the position of managing director at the end of 1921, but this did not involve the severance of his active relations with the firm, which he retained to the end. Although Mr. Rossiter Hoyle was born in Manchester, he was a member of an old Yorkshire family. His father was one of the chief men at Messrs. Armstrong's works, and was chief assistant to Sir Andrew Noble. After being educated privately and at Owen's College, he went abroad. Afterwards he entered the employ of his brother-in-law, Mr. C. W. Burton, who represented Burys & Company, a Sheffield steel firm. Subsequently Mr. Hoyle went into the engineering business in Paris, serving what may be described as an apprenticeship to the practical side of the business. Through business interests Mr. Hoyle came into touch with the late Mr. C. H. Firth, at the time when the firm of Thomas Firth & Sons had secured a contract with the French Government. Mr. Hoyle went to Sheffield about the year 1881, and thus began his close personal association with that city, extending over the long period of 45 years. For some time Mr. Hoyle continued as manager of Firth's gun works, and in 1885 built the company's steel plant in Sheffield. In 1893 Mr. Hoyle became a director of the firm, and when his co-managing director, Mr. Lewis J. Firth, went to America to control the Firth Sterling Steel Company, in Pittsburgh, Mr. Hoyle assumed the entire direction of the Sheffield business. In 1912 he became Master Cutler.

Company Meetings.

W. Canning and Company, Limited.—In moving the adoption of the report at the annual meeting of this company in Birmingham, on March 15, MR. E. R. CANNING (chairman and managing director) referred to the fact that provision had been made for all wage-earners in the company to benefit from the company's prosperity. The scheme provided that each employee of one year's standing and over received a bonus according to his earnings and length of service. To those employees not having a bank account or a Post Office savings account, the amount due was paid into the Municipal Bank, a separate account being opened for each, and the amount placed to their credit. The directors hoped by paying the amount into the bank to acquaint the worker with the meaning and value of interest. The scheme had been much appreciated, and, the directors considered, had been the means of producing a more contented worker.

Swan, Hunter and Wigham Richardson, Limited.—MR. T. E. THIRLAWAY presided at the annual meeting at Newcastle on March 15. Moving the adoption of the annual report, Mr. Thirlaway said that the past year had been probably the most difficult in the history of shipbuilding, and he discerned no signs of real improvement yet. The contracts which had been placed recently were in practically all cases for special type vessels. There was little or no demand for the ordinary cargo tramp. While the cost of construction was, under the present standard of values, comparatively low, the shipbuilding industry at present could not support increased costs. Shipbuilders were now building without any profit, and any increase of costs would mean building at a loss. Only close co-operation between the employers, their staffs, and their workmen could prevent serious loss, and any increase of costs—as British costs were already higher than the costs of materials and labour in foreign countries—would send contracts for ships to Holland, Germany, Sweden, and France, instead of to the British shipyards.

OWING TO THE Easter holidays, the quarterly meeting of the iron trade on the Birmingham Exchange will be held on April 15, not April 8.

MR. A. HOARE, of Dundee, has been appointed engineering manager to J. Samuel White & Company, Limited, of East Cowes, Isle of Wight.

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron trade continue unsatisfactory from a market point of view, and although in well-informed circles the labour outlook is regarded with much less apprehension than was recently expressed, new business is certainly on a much diminished scale, both in the home and export sections. The present slackness of demand is doubtless due to some extent to the prevailing uncertainty with regard to the final outcome of the miners' trouble, which has been further accentuated by the crisis in the engineering industry, and the unsettled condition of Continental exchanges, but even with these difficulties in process of solution there still remains the question of prices, which are deemed too high by the average consumer. Cleveland producers are considered by buyers as demanding a figure which consumers are not prepared to pay, in view of favourable offers by Continental smelters, and are therefore withholding contracts usually placed at this period of the year. In the export trade the recent set-back to the franc only makes the position worse, so that the outlook for Cleveland iron abroad is pretty hopeless. At last week's market makers gave no indication of any change of attitude, and the market was practically idle. The following are current export f.o.b. prices, quotations for home consumption being 6d. per ton less :—No. 1, 73s. ; No. 3 G.M.B., 70s. 6d. ; No. 4 foundry, 69s. 6d. ; and No. 4 forge, 68s. 6d. per ton.

While the hematite position is undoubtedly rather easier, producers as a rule are still fairly well placed, and there is no great pressure to sell. The sellers' quotation for East Coast mixed numbers is held at 77s. per ton, but a slightly lower figure could be successfully negotiated for a good order. The No. 1 quality is 6d. per ton more. On the North-West Coast quotations remain steady as follow :—Bessemer mixed numbers, £4 2s. 6d. c.i.f. Welsh ports; £4 7s. 6d. per ton delivered at Glasgow ; £4 10s. delivered at Sheffield ; and £4 13s. 6d. delivered at Birmingham.

LANCASHIRE.—In this district the comparative scarcity of fresh current business has had no effect on the prices that are being quoted, for values of foundry pig are maintained in all sections of the local market. Derbyshire No. 3 foundry iron is still being offered at from 75s. to 76s. 6d. per ton, delivered in this area, while Staffordshire and Lincolnshire are at 76s. to 77s.

THE MIDLANDS.—In South Staffordshire and the immediate districts the near approach of the quarterly meeting may probably account for the present quiet condition, buyers of foundry pig apparently awaiting developments, and meanwhile remaining content with hand-to-mouth purchases. Meanwhile current quotations remain as follow :—Derbyshire No. 3 foundry, 66s. 6d. to 67s. 6d. ; Staffordshire No. 3 foundry, 66s. 6d. to 67s. 6d. ; Northants. No. 3 foundry, 62s. 6d. to 63s. 6d.

SCOTLAND.—The depression previously reported in the Scotch pig-iron trade has undergone no improvement, and the volume of business transacted in this market is much below the usual average for the season, buying being confined to immediate necessities.

Metals.

Copper.—Values of standard copper during the past week have been maintained at steady levels, the rally in Wall Street and encouraging advices regarding domestic consumption in the United States, together with a more reserved attitude on the part of holders here creating a better feeling. Some strength was also derived from reports of increased trade activity in Germany. An improved business has been done on domestic account. Current quotations :—*Cash* : Thursday, £59 5s. ; Friday, £59 2s. 6d. ; Monday, £58 17s. 6d. ; Tuesday, £58 10s. ; Wednesday, £58 5s.

Three Months : Thursday, £60 2s. 6d. ; Friday, £60 ; Monday, £59 15s. ; Tuesday, £59 7s. 6d. ; Wednesday, £59 5s.

Tin.—With continuous advances over the past week, the settlement price reached £299 per ton on Wednesday last. The opening price was £300 10s. This is the highest quotation since 1920, during which year the record price of £419 10s. was reached. At the beginning of this year tin commanded £289 5s. per ton, but by the end of January it had fallen to £274. Since then, however, there has been an almost uninterrupted series of daily advances, and the price is now within easy reach of the long-predicted £300 per ton mark. Current quotations :—*Cash* : Thursday, £294 ; Friday, £293 15s. ; Monday, £292 10s. ; Tuesday, £292 5s. ; Wednesday, £291.

Three Months : Thursday, £285 15s. ; Friday, £285 5s. ; Monday, £284 ; Tuesday, £283 10s. ; Wednesday, £282 10s.

Spelter.—Consumptive demand by home consumers has been limited in volume. Rudolf Wolff state :—Circumstances surrounding the general situation have offered little or nothing by way of incentive to buy, and prices, therefore, on the whole, have fallen more by reason of general apathy of buyers and lack of support than any great pressure to sell. The weaker tendency might, perhaps, be more particularly ascribed to the condition of affairs on the Continent. Current quotations :—*Ordinary* : Thursday, £33 18s. 9d. ; Friday, £34 ; Monday, £34 1s. 3d. ; Tuesday, £33 17s. 6d. ; Wednesday, £33 12s. 6d.

Lead.—With regard to the market for soft foreign pig, Henry Gardner & Company write that the A.S. & R. Company continue to reduce their quotation. Although this is scarcely more than a measure of self-defence against the weakness on this side, it cannot act otherwise than as a depressing influence on sentiment there. Current quotations :—*Soft foreign (prompt)* : Thursday, £32 2s. 6d. ; Friday, £32 ; Monday, £31 16s. 3d. ; Tuesday, £31 12s. 6d. ; Wednesday, £31 1s. 3d.

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(Registered).

THE REFRACTORY OF STANDING.

50% Saving

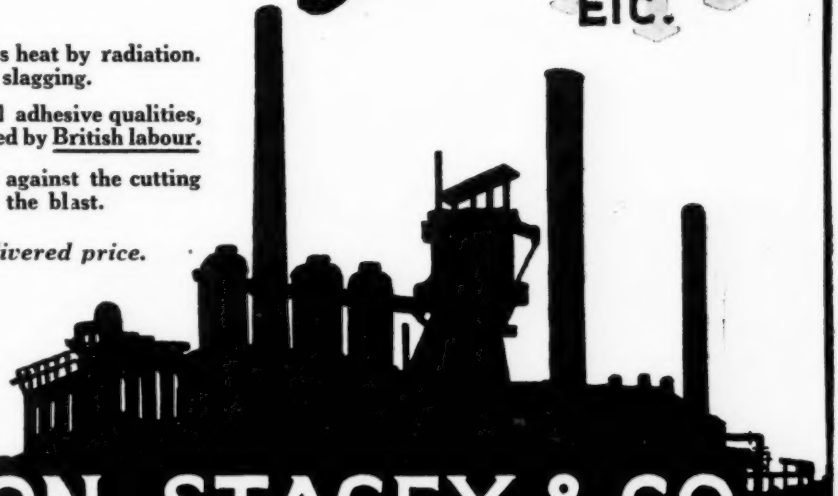
For the lining of CUPOLAS, STEEL CONVERTERS Etc.

SILCRETE Promotes heat by radiation. Reduces slagging.

Possesses exceptional adhesive qualities, is plastic and produced by British labour.

SILCRETE is proof against the cutting down of the blast.

Write now for delivered price.



DIXON, STACEY & CO.,

34/35 NORFOLK STREET, STRAND, LONDON, W.C.2.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	58	5	0
Three months ..	59	5	0
Electrolytic	65	5	0
Tough	61	0	0
Best selected ..	61	15	0
Sheets	90	0	0
India	75	0	0
Wire bars	66	0	0
Do. April	65	10	0
Do. May	65	10	0
Ingot bars	65	10	0
H.C. wire rods ..	69	15	0
Off. av. cash, Feb.	59	14	7½
Do., 3 mths. Feb.	60	14	8½
Do., Sttlmnt, Feb.	59	14	1½
Do., Electro, Feb.	66	12	6
Do., B.S., Feb. ..	64	0	0
Aver. spot price copper, Feb. ..	59	14	1½
Do., wire bars, Feb.	66	17	6
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			10d.

BRASS.

Solid drawn tubes ..	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	291	0	0
Three months ..	282	10	0
English	289	0	0
Bars	292	15	0
Straits	293	10	0
Australian	292	15	0
Eastern	287	5	0
Banca	293	0	0
Off.aver. cash, Feb.	287	4	9
Do., 3 mths., Feb.	280	4	4½
Do., Sttlmt. Feb.	287	3	6
Aver. spot., Feb.	287	3	6

SPELTER.

	£	s.	d.
Ordinary	33	12	6
Remelted	34	0	0
Hard	28	5	0
Electro 99.9 ..	38	7	6
English	34	10	0
India	30	15	0
Zinc dust	43	0	0
Zinc ashes	15	0	0
Off. aver., Feb. ..	36	0	1½
Aver., spot, Feb.	36	1	0¾

LEAD.

	£	s.	d.
Soft foreign ppt.	31	1	3
English	32	10	0
Off. average, Feb.	33	18	0¾
Average spot, Feb.	33	18	0¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	42	10	0
Do. V.M. ex whf.	40	10	0
Rods	46	0	0
Boiler plates ..	40	0	0
Battery plates ..	39	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	99	0	0
Chinese	83	10	0
Crude	57	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver ..	14	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	£9 10 0
45/50%	£11 14 0
75%	£20 12 6
Ferro-vanadium—	
35/40%	14/5 lb. va.
Ferro-molybdenum—	
70/75% c. free	6/- lb.
Ferro-titanium—	
23/25% carbonless	11½d. lb.
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%, c.fr. ..	1/9½ lb.
Tungsten metal powder—	
98/99%	2/1 lb.
Ferro-chrome—	
2/4% car. ..	£35 0 0
4/6% car. ..	£22 17 6
6/8% car. ..	£21 15 0
8/10% car. ..	£20 17 6
Ferro-chrome—	
Max. 2% car.	£39 5 0
Max. 1% car.	£44 10 0
Max. 0.70% car.	£55 10 0
70%, carbonless	1/5½ lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£112
Metallic Chromium—	
96/98%	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 10 0
76/80%, packed	£16 10 0
76/80%, export	£15 0 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. and over .. 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼ in. to ⅛ in. .. .. 1/- lb.
Flats, ½ in. × ¼ in to under 1 in. × ⅜ in. 3d. lb.
Do. under ½ in. × ¼ in. 1/- lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf 1d.

Per lb. net, d/s steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	8	6 to	3	12	6
Bundled steel & shrngs.	3	3	6 to	3	7	6
Mixed iron & steel	3	2	6 to	3	4	0
Heavy cast iron	3	2	6 to	3	5	0
Good machinery for foundries	3	7	6 to	3	10	0
Cleveland—						
Heavy steel ..		3	4	6		
Steel turnings ..		2	7	6		
Cast iron borings		2	5	0		
Heavy forge ..		4	5	0		
Bushelled scrap		3	10	0		
Cast-iron scrap		3	5	6		
Lancashire—						
Cast-iron scrap	3	10	to	3	15	0
Heavy wrought		3	10	0		
Steel turnings ..		2	0	0		

London — Merchants' buying prices delivered yard.

Copper (clean) ..	50	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	28	0	0
Tea lead ..	24	0	0
Zinc	23	0	0
New aluminium cuttings ..	85	0	0
Braziery copper	45	0	0
Gunmetal ..	46	0	0
Hollow pewter	190	0	0
Shaped black pewter ..	144	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	72/6
Foundry No. 3 ..	70/-
Foundry No. 4 ..	69/-
Forge No. 4	68/-
Hematite No. 1 ..	77/6
Hematite M/Nos. ..	77/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/6
„ d/d Birm.	94/3
Midlands—	
Staffs common* ..	—
„ No. 4 forge ..	62/6
„ No. 3 foundry	67/-
Shrops. basic	70/-
„ Cold blast, ord.*	185/-
„ „ roll iron* ..	190/-
* d/d Birmingham.	
Northants forge	56/6
„ fdry No. 3 ..	63/-
Derbyshire forge ..	62/-
„ fdry. No. 3 ..	67/-
„ basic	65/-
Scotland—	
Foundry No. 1 ..	81/6
„ No. 3 ..	76/6
Hem. M/Nos.	76/6
Sheffield (d/d district)—	
Derby forge	66/-
„ fdry. No. 3 ..	71/-
Lincs. forge	67/6
„ fdry. No. 3 ..	70/-
E.C. hematite	87/6
W.C. hematite ..	90/-
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3	64/-
Basic	64/-
Lancashire (d/d eq. Man.)—	
Derby forge	69/6
„ fdry. No. 3 ..	75/-
Northants foundry No. 3	75/9
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	94/-
Glengarnock, No. 3 ..	94/-
Gartsherrie, No. 3 ..	94/-
Monkland No. 3	94/-
Coltness, No. 3	94/-
Shotts, No. 3	94/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars(cr.)	11	0	0 to	12	0	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt	10	5	0 to	10	7	6
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t. ..				14	0	0
Gas strip				12	10	0
Bolts and nuts .. ¾ in. × 4 in. ..				15	15	0
Steel—						
Ship plates	7	7	6 to	7	17	6
Boiler plts. ..				11	10	0
Chequer plts. ..				9	15	0
Angles	£7	0	0 to	7	5	0
Tees	£8	0	0 to	8	5	0
Joists	£7	0	0 to	7	5	0
Rounds and Squares 3 in. to 5½ ins. ..				8	0	0
Rounds under 3 in. to ⅜ in.				7	15	0
Flats, over 5 in. wide and up ..				8	10	0
Flats, 5in. to 1½in.				7	10	0
Rails, heavy ..				8	0	0
Fishplates				12	0	0
Hoops (Staffs.) ..				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	0	0
Galv. fencing wire 8g. plain				14	0	0
Billets, soft	£6	2	6 to	6	5	0
Billets, hard ..		8	2	6		
Sheet bars	6	0	0 to	6	2	6
Tin bars d/d	6	2	6 to	6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb. basis.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.26
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	100.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.85
Beams, etc.	1.90
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28 ..	3.25
Sheets, galv., No. 28 ..	4.50
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry ..	32/6 to 37/6
„ furnace ..	20/- to 25/-
Durham & North.	
„ foundry	30/- to 33/-
„ furnace ..	15/-
Other Districts, foundry	30/- to 33/-
„ „ furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/4½
„	28×20, „	38/9
„	20×10, „	29/1½
„	18¾×14, „	20/4½
C.W.	20×14, „	17/7½
„	28×20, „	35/1½
„	20×10, „	24/1½
„	18¾×14, „	18/4½

Terneplates 28×20, 35/7½ per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/15/0 to £16/5/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 10 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.		
Mar. 18	59	5	0	inc.	2/6
,, 19	59	2	6	dec.	2/6
,, 22	58	17	6	,,	5/–
,, 23	58	10	0	,,	7/6
,, 24	58	5	0	,,	5/–

Electrolytic Copper.

	£	s.	d.		
Mar. 18	66	5	0	inc.	5/–
,, 19	66	0	0	dec.	5/–
,, 22	65	15	0	,,	5/–
,, 23	65	10	0	,,	5/–
,, 24	65	5	0	,,	5/–

Standard Tin (Cash).

	£	s.	d.		
Mar. 18	294	0	0	dec.	72/6
,, 19	293	15	0	,,	5/–
,, 22	292	10	0	,,	25/–
,, 23	292	5	0	,,	5/–
,, 24	291	0	0	,,	25/–

Tin (English ingots).

	£	s.	d.		
Mar. 18	292	15	0	dec.	70/–
,, 19	292	5	0	,,	10/–
,, 22	291	0	0	,,	25/–
,, 23	291	0	0	No change	
,, 24	289	0	0	dec.	40/–

Zinc Sheets (English).

	£	s.	d.		
Mar. 18	43	0	0	No change	
,, 19	42	10	0	dec.	10/–
,, 22	42	10	0	No change	
,, 23	42	10	0	,,	,,
,, 24	42	10	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
Mar. 18	33	18	9	inc.	3/9
,, 19	34	0	0	,,	1/3
,, 22	34	1	3	,,	1/3
,, 23	33	17	6	dec.	3/9
,, 24	33	12	6	,,	5/–

Lead (English).

	£	s.	d.		
Mar. 18	33	10	0	inc.	5/–
,, 19	33	5	0	dec.	5/–
,, 22	33	5	0	No change	
,, 23	33	0	0	dec.	5/–
,, 24	32	10	0	,,	10/–

Exports of Iron Castings in February and the two months 1926, compared with February and the two months 1925.

	February, 1925	February, 1926	Two months, 1925	Two months, 1926	February, 1925	February, 1926	Two months, 1925	Two months, 1926
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
BUILDERS' CASTINGS—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	140	150	267	282	4,735	5,692	8,935	11,358
,, British South Africa	404	492	661	877	14,120	16,258	24,636	29,321
,, ,, East Indies	175	195	308	332	8,185	8,170	15,089	13,807
,, Australia	96	120	137	228	5,782	6,080	7,970	11,966
,, New Zealand	361	344	510	494	15,315	14,655	23,190	23,478
,, Other countries	526	694	1,290	1,253	28,043	33,896	66,180	63,471
Total	1,702	1,995	3,173	3,466	76,180	84,751	146,000	153,401
PIPES AND FITTINGS—								
Cast—								
To Argentine Republic	684	813	1,461	1,235	10,331	10,966	20,516	16,673
,, British South Africa	565	748	767	1,154	9,059	11,028	12,347	17,094
,, ,, India	1,591	1,242	2,370	1,972	20,670	14,327	34,386	22,634
,, Straits Settlements & Malay States	575	456	860	5,250	5,450	5,784	8,772	40,975
,, Ceylon	165	368	311	788	2,256	4,168	4,164	8,414
,, Australia	406	723	675	1,059	6,347	7,904	10,140	13,936
,, Other countries	4,074	4,558	8,174	8,747	67,082	64,442	132,128	124,539
Total	8,058	8,908	14,618	20,205	121,195	118,619	222,453	244,265
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	831	640	1,578	1,296	25,562	23,201	50,815	43,756
,, Enamelled	113	66	216	153	11,258	8,025	20,090	17,279
CASTINGS, in the rough—								
Iron	156	142	247	239	6,212	3,633	10,445	7,765
Steel	21	102	79	206	984	2,877	2,944	6,129

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

93, HOPE STREET, GLASGOW.

ROYAL EXCHANGE, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN, recently returned from South America, desires similar position in England or abroad.—For further particulars, Box 662, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOREMAN MOULDER wanted for Iron Foundry dealing with medium and heavy castings; must be a practical moulder and able to fix piece-work rates.—Write, stating age, fullest details of experience and wage required, Box 650, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRYMAN, having first-class experience in Ironfounding, and 5 years in business for self, desires position as Foreman or Manager; knows what to expect from a foundry of to-day; able to build up business, and prepared to accept position in England or abroad; age 32; I.B.F. man.—Apply, Box 638, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY MANAGER wanted: able control 80 Moulders producing Light and Medium Grey Iron Castings; must understand thoroughly production of high-class work and fixing of prices. State experience and salary expected, and enclose copies testimonials.—Box 676, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WORKING FOUNDRY FOREMAN required, with good practical experience of Stump and Machine Moulding, small Castings, Cupola work, Annealing by Dowson & Mason Gas Oven; single man preferred; must be good organiser; London district.—Full particulars, Box 678, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY

SECOND-HAND TABOR Portable Combination Shockless Jarring Rollover and Pattern-drawing Moulding Machine, 24 in. x 48 in., WANTED.—Apply Box 674, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ELECTRIC FURNACE for disposal, 50 cwts. capacity, complete with Transformers and full equipment; condition as new.—Further details on application to Box 646, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CUPOLA, Lloyd's Fan, Moulding Boxes, Evans' Ladles with Shanks, Minister of Transport Direction Post, Patterns with Moulding Boxes, Morgan Crucibles, Carriers, Tongs, Wire Brushes, Riddles, Ganister, Rammers, Plumbago, etc., etc.—FISHER & SWAIN, Victoria Foundry, Yeovil.

TILGHMAN SANDBLAST ROOM, 12 ft. x 9 ft., with all necessary equipment; Compressor Receiver and Fan, for Sale, cheap.—Box 680, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MOULDING MACHINES.

Two No. 2 Denbigh Hand Jolters, £16 each; two 14 in. x 16 in. Tabor Squeezers, as new, £60 each; two 24 in. x 16 in. Mumford Plain Jolters, £12 each; two 30 in. x 20 in. Mumford Plain Jolters, £24 each; one 42 in. x 30 in. Mumford Plain Jolter, £42; one 60 in. x 50 in. Evans Plain Jolter, £140; one 72 in. x 72 in. Mumford Plain Jolter, £310.

Several Sand Sifters, Sand Mixers and Sand Mills. Every size of Fan and Blower in stock. All sizes and types of Air Compressors in stock.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND,

FOUNDRY MACHINERY MERCHANT,

14, AUSTRALIA ROAD, SLOUGH.

MACHINERY.—*Continued.*

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MACHINERY, PLANT, &c.

HORIZONTAL STEAM-DRIVEN AIR COMPRESSOR, 14-in. steam cyl., 14-in. air, 16-in. stroke, by American Well Works Co.

SENTINEL AIR COMPRESSOR, 260 cubic ft. capacity at 100 lbs. pressure; driven by 55-h.p. motor, 500 volts.

HORIZONTAL BELT-DRIVEN AIR COMPRESSOR, 15-in. cyl., 11-in. stroke, 448 cubic ft. capacity at 70 lbs.; by Robey.

BELT-DRIVEN SINGLE-STAGE QUADRUPLEX AIR COMPRESSORS, by Reavell; capacity, 330 cubic ft. at 80/100 lbs. pressure.

LANCASHIRE BOILER, 30 ft. x 7 ft. 6 in. diam.; reinsure 120 lbs. pressure.

TWO LOCO-TYPE BOILERS, 11 ft. 6 in. long, barrel 2 ft. 8 in. diam.; reinsure 170 lbs. pressure.

CATALOGUE (10,000 LOTS) ON APPLICATION.

THOS W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

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